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COASTWATCH

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The 200-mile limit: slowly but surely taking hold

It's been about two years since the Fishery Conservation and Management Act (FCMA) went into effect. In that time, the concept of 200 mile fishery conservation zones has become an accepted international standard. In the United States (US), the act's major effects have been two-fold:

—Foreign fishing within 200 miles of US shores has decreased by 27 percent, according to John M. Murphy, chairman of the House Merchant Marine and Fisheries Committee. In fact, on the East Coast, foreign vessels have taken catches well below their allocations.

—Domestic fishing, according to Representative Murphy, has increased by 8 percent. Observers say the increase in domestic fishing will be gradual because some of the fisheries must rebuild.

But fewer than 10 of the more than 70 fishery management plans being developed by the eight regional management councils around the country have actually been implemented. As those plans go into effect, domestic fishermen are coming under regulations ranging from mandatory catch reporting to gear restrictions. (Preliminary management plans were drawn up to exclude or reduce foreign fishing in jeopardized fisheries.)

The plans, which are drawn up to manage fishery resources for individual species, affect recreational as well as commercial fishermen. Seven plans are being drafted by the South Atlantic Fishery Management Council, which has jurisdiction from North Carolina to the east coast of Florida. "Most of them are really going to affect recreational fishermen," says Ed McCoy, of the North Carolina Division of Marine Fisheries and a member of the South Atlantic council.

Many fishery resources are at or near full exploitation, according to Ernie Premetz, executive director of the South Atlantic Fishery Management Council. The stocks for which there is most concern are billfish, swordfish and some species in the snapper-grouper and mackerel complexes. Those fisheries are primarily recreational.

With the exception of the billfish fishery, there has been little foreign ac-

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Hey look at us. We're still the Sea Grant College newsletter, but we've made a few improvements. We've given ourselves a name, *Coastwatch*, which says in a nutshell what we're all about. We've redesigned the newsletter to make it more readable and attractive. And we've added a new section "The Back Page" which will keep you informed of progress in Sea Grant research, marine education, recreation, advisory services and publications. We hope you'll approve. Be sure to let us know what you think of our new format.

We'd like to thank those of you who responded to the survey we sent out (one out of five readers was randomly chosen to receive it). Many of your suggestions are incorporated in the changes you see here.

Sport fishing off Morehead City, North Carolina tivity in the South Atlantic fisheries. According to Premetz foreign fleets have been inching their way south as stocks to the north dwindled. The FCMA, he says, put constraints on the development that might have occurred.

"The south Atlantic area (has) a very high concentration of recreational fishing," according to Ben Hardesty, chairman of the South Atlantic council. "Indications are that the recreational fisherman is taking a bigger percentage of snapper-grouper and the mackerel and also the billfish than commercial interests are."

While it is difficult to say how many commercial or sports fishermen fish off North Carolina, it is generally agreed that recreational fishing accounts for a significant portion of the catch. Certainly, in terms of numbers of people involved, recreational fishermen far outnumber commercial fishermen.

FCMA and commercial fisheries—restrictions, and the hope of more fish to catch

Gene Huntsman, of the National Marine Fisheries Service in Beaufort, reports that last year 134 charter boats (which usually carry small, private fishing parties) made 9,755 trips for a total of 58,530 angler days. About 1.85 million pounds of fish were landed. Huntsman suspects that those 58,530 angler days represent almost that many individuals. Add to that the 22,661 angler days spent on head or party boats and the unknown number of saltwater fishermen in private boats and the numbers really mount up. While the FCMA won't drastically affect all offshore recreational fishermen, it will bring some changes. Among the new regulations will be minimum catch sizes for some species and mandatory reporting on a sampling basis.

As for commercial fishermen, the FCMA involves restrictions, of course, but it also offers the hope of more fish to catch and sell. For example, the Mid-Atlantic Fishery Management Council (Virginia to New York) is drawing up management plans for butterfish and squid which are intended to encourage development of those fisheries.

While the FCMA's effect on North Carolina commercial fishermen has been minimal, the industry is expanding, according to observers. The value and volume of the state's catch have been steadily increasing for the last eight years and there has been a gradual upgrading of the fleet.

Construction has begun on the seafood park at Wanchese and there's been talk of similar parks elsewhere in the state. Efforts to export more fish—particularly underutilized species—from the region seem to be broadening. According to Chuck Oravetz of the National Marine Fisheries Service, Nigeria and Egypt are interested in mullet from the south Atlantic.

Sea Grant advisory agent Skipper Crow reports that 21 steel-hulled boats 80 feet or longer are being built for North Carolina fishermen right now. The larger boats will enable fishermen to fish farther offshore. There are some signs that fish houses may be expanding and enlarging their own fleets. McCoy says fishermen are seeing they have "got to be able to go where the fish are. You can't necessarily do that within sight of land."

Plans include recreational fisheries, too

The South Atlantic Fishery Management Council has seven plans in the works right now. But it looks as though it may be next spring before any of the plans takes effect.

The Fishery Management Plans being developed are for: the snapper-grouper complex, king and Spanish mackerel, billfish, swordfish, precious corals, spiny lobster and calico scallops. Work will begin late this summer on a rock and royal shrimp plan. Once plans are completed, they face public hearings and a 200- to 300-day waiting period for completion of federal procedures.

The one regulation common to all the plans under consideration is mandatory reporting of catch. Some form of reporting likely will be required for all species for which there is a plan. While no final decisions have been made, it looks as though full reporting of catch will be required for commercial and commercial recreational vessels such as head or charter boats.

In the case of recreational fishing, the reporting likely will involve sampling. A portion of those recreational fishermen who indicate at the time of licensing that they fish saltwater will be required to report their catches for a given period. While the licensing or permitting details have not been worked out, Jackson Davis of the South Atlantic council staff says the council can require permits for any vessels fishing in the Fishery Conservation Zone.

Thousands of pounds of fish are caught aboard head boats yearly

Additional requirements may apply to both commercial and recreational fishermen and may include: size limitations on catch; gear and season limitations; and quotas. Where quotas are set, according to Ernie Premetz, executive director of the South Atlantic management council, they generally maintain the status quo and do not limit existing fishing effort. But when the quota or optimum yield is reached, a fishery may be closed for the season. Size limitations will affect current fishing practices somewhat, Premetz adds.

Besides being affected by the actions of the South Atlantic Fishery Management Council, fishermen from the region who fish off the coasts of other states will be subject to the regulations of other councils. For example, the New England council will be developing a sea scallop plan and the mid-Atlantic council a river herring plan. North Carolina fishermen participate in both those fisheries to the north. In addition, the mid-Atlantic council is considering drawing up a bluefish plan. Hearings will be held on that subject this spring.

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FCMA's building blocks

FCMA—Fears of stock depletion led Congress to pass the Fishery Conservation and Management Act of 1976. The act authorizes management of fishery resources from three to 200 miles off the US coast. It states that US fishermen will get first crack at allowable catches within that zone and that surpluses may be allotted to foreign vessels.

FCZ—The Fishery Conservation Zone is the area covered by the act. It includes the waters three to 200 miles out at sea. Not included is the territorial sea which is the area within three miles of shore where individual states have jurisdiction.

Regional fishery management councils—Eight regional councils are charged with implementing the FCMA. Representatives from each state in a region include mandatory state and federal officials as well as appointed members. The Secretary of Commerce has final approval of the Fishery Management Plans which the councils draw up. Plans are drawn up to manage individual species within each region.

Optimum yield—The quota that the council arrives at after considering biological, socio-economic and ecological information on a given fishery is the optimum yield. It is the crux of the Fishery Management Plan. Optimum yield is then allotted to domestic and sometimes foreign fishermen.

Size limits, reporting are part of plans

Here are some specifics on the tentative plans which are closest to completion in the South Atlantic council. In some cases the full council has approved the measures and in others they are simply committee recommendations. All are subject to change as the plans are developed. The council has jurisdiction from North Carolina through the east coast of Florida.

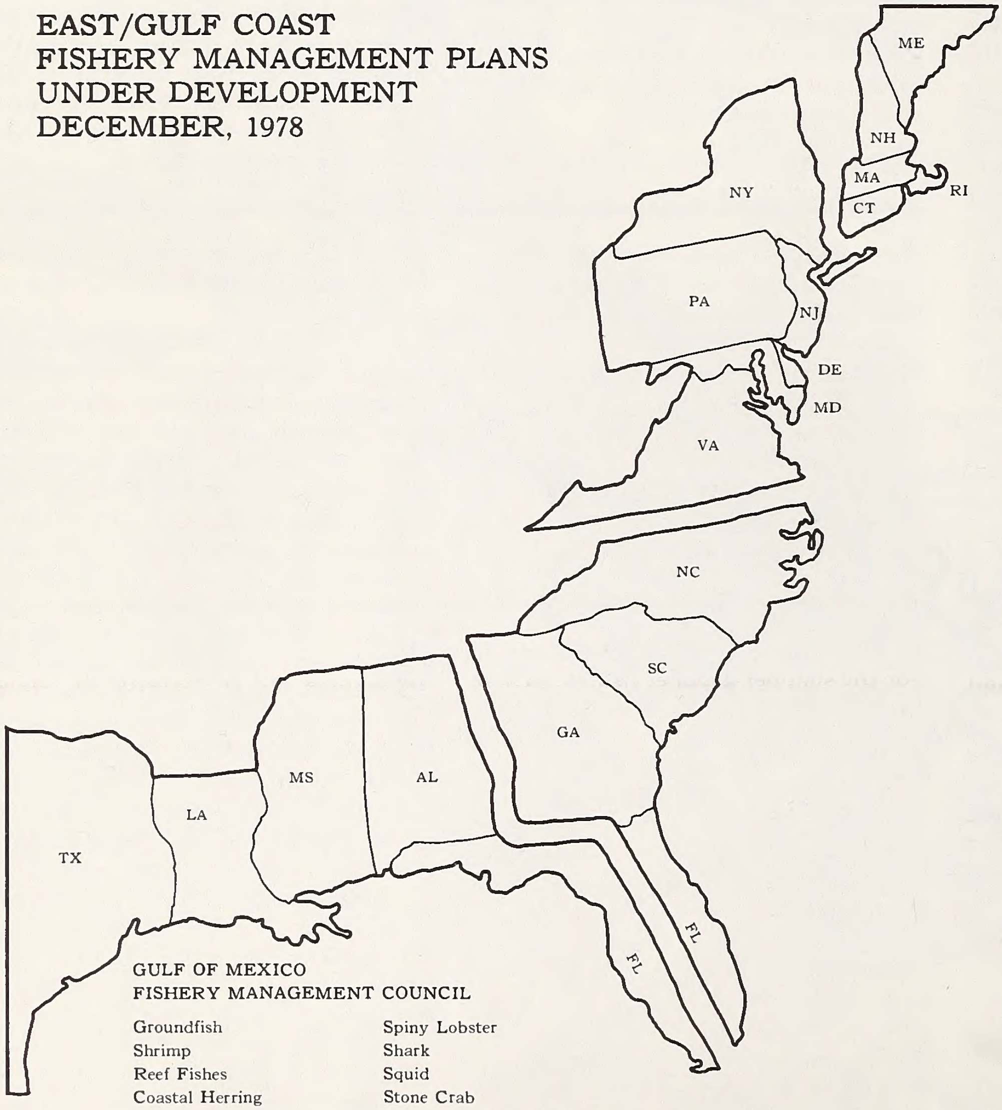
Mackerel—While king mackerel, Spanish mackerel and cobia are included in the plan, Premetz says that the king mackerel is under the greatest stress now and will be subject to more regulation. A final draft of this plan is expected in April or May, according to Premetz.

The plan, which is being developed jointly with the Gulf of Mexico Fishery Management Council, sets an optimum yield or total maximum allowable catch of 37 million pounds for king mackerel. It will be illegal to sell any king mackerel under 25 inches in length. A minimum mesh size for gill nets of four and three-quarters inches stretch will be required.

The greatest allocation of king mackerel, 28 million pounds, goes to recreational fishermen. Commercial fishermen are allotted 9 million pounds. As the optimum yield is approached, Premetz says management measures would include bag limits for recreational fishermen, closed seasons by area and time for both commercial and recreational fishermen, pound or haul quotas for commercial net boats, and daily catch limits for commercial hook and line fishermen.

The council also is considering excluding purse seines from the fishery because, according to Premetz, "they are reluctant to open the fishery to any new highly efficient gear without determining the impact." A study has

EAST/GULF COAST
FISHERY MANAGEMENT PLANS
UNDER DEVELOPMENT
DECEMBER, 1978



NEW ENGLAND
FISHERY MANAGEMENT COUNCIL

Atlantic Herring
Scallop
Red Fish
Hake (Silver)
Pollock
Other Hake
Red Crab
Northern Shrimp

Atlantic Groundfish for 1977*
Atlantic Groundfish Amendment #1*
Atlantic Groundfish Amendment #2*
Atlantic Groundfish for 1979

MID-ATLANTIC
FISHERY MANAGEMENT COUNCIL

Atlantic Mackerel
Butterfish
Shark
American Lobster
Bluefish
Scup
Sea Bass
Fluke

Surf Clam and Ocean Quahog Fisheries*
Squid Fishery of NW Atlantic
American Shad, Hickory Shad and River Herring

SOUTH ATLANTIC
FISHERY MANAGEMENT COUNCIL

Billfish
Snapper-Grouper Complex
King and Spanish Mackerel
Swordfish
Precious Corals
Spiny Lobster
Calico Scallops

GULF OF MEXICO
FISHERY MANAGEMENT COUNCIL

Groundfish
Shrimp
Reef Fishes
Coastal Herring
Precious Corals
Gulf Swordfish
Spiny Lobster
Shark
Squid
Stone Crab
Coastal Migratory Pelagics

*Plan Implemented

been initiated on that question.

For Spanish mackerel, the optimum yield probably will be 27 million pounds. A 12-inch minimum length has been recommended for catches in both the commercial and recreational fisheries. Premetz says there seems to be no need for allocation now, but the purse seine issue is being considered for Spanish mackerel too.

For cobia the council is considering a minimum catch size of 33 inches for both the commercial and recreational fisheries. Premetz says that a minimum length in any fishery is a size which the council believes allows maximum yield per fish. The fish has an opportunity to spawn at least once and perhaps twice.

Snapper-grouper—This group is divided geographically into four management units: black sea bass in the northern range; and three distinct species complexes, one north of Cape Canaveral, one south of Cape Canaveral and one in the deep water farther offshore. The draft plan for this commercial and recreational fishery is expected this summer.

The two problem areas, according to Premetz, are the black sea bass and the complex which is found south of Cape Canaveral, Florida. Included in that group are mangrove snapper, yellow tail snapper, mutton snapper, lane snapper, inshore groupers, grunts and porgies. Premetz says in both cases there is gross overfishing with undersized fish being taken.

The quota for black sea bass is 1.6 million pounds. A minimum size of 9 inches for black sea bass will be imposed in both the recreational and commercial fisheries.

For the area south of Canaveral, the quota is 8.9 million pounds. Premetz says that once more information is compiled, minimum catch size also should be set for species in the south Florida area.

The area north of Canaveral supports fisheries for gag, scamp, red porgie, red snapper, vermillion, grunts, hind and trigger fish. That quota is 4.1 million pounds. The quota for the deep water complex is 1.5 million pounds. Premetz says that fishery, which includes snowy grouper, yellow-edged grouper, black tile fish, golden tile fish and red porgie, still has considerable room for expansion.

Other restrictions being considered for the snapper-grouper fishery include regulations on fish traps. Included are limits on the number of traps to be fished by a given vessel and requirements for degradable panels in the traps. Zoning of artificial reefs also is being considered. And trawling efforts will be watched to see if controls are needed on that type of fishing.

Billfish—Included in the plan are blue marlin, white marlin and sailfish. The South Atlantic fishery council is taking the lead for five regional councils in the development of the billfish plan. The final draft is expected this month.

Under the plan, billfish will be strictly a domestic recreational fishery. Given the extent of the domestic fishery and its economic importance, no surplus will be declared for foreign vessels.

Foreign fishermen already are excluded from the billfish fishery under a Preliminary Management Plan (promulgated by the Department of Commerce as an interim measure). However, according to council staff member Davis, the council is caught in a legal dilemma: the FCMA specifically excludes tuna from US jurisdiction within the 200 mile Fishery Conservation Zone. Japanese longliners have continued to take tuna within the FCZ and, since the billfish often are an incidental catch in the tuna fishery and since "they get a good price for them too," says Davis, it may be difficult to protect the fishery entirely.

Winner: times have changed

Skippy Winner of Wilmington has spent most of his 44 years on boats. Along with his family he operates half a dozen head and charter boats for recreational fishing. Twenty years ago, Winner says, the boats didn't have to go out of sight of land to fish. "You could catch all the fish you wanted. . . Now nobody slows down till they get out of sight of land. So the fishing has greatly declined.

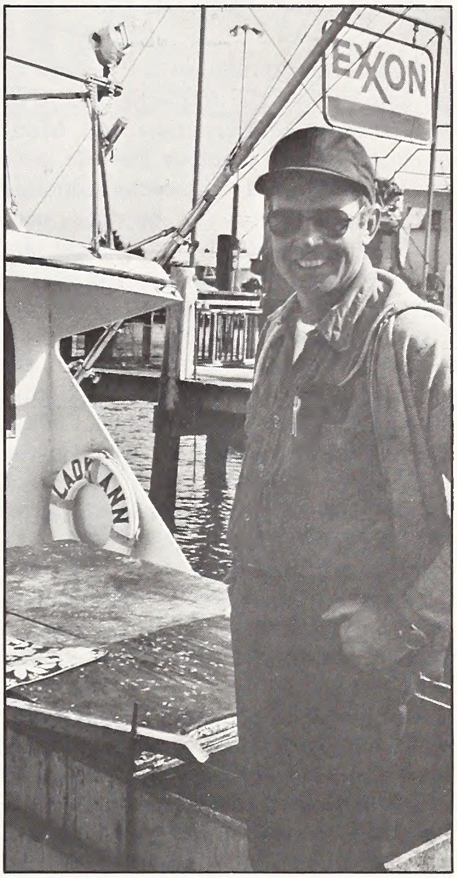
"There are less fish of all species. Black (sea bass) fishing is nowhere like it was."

Fishing for snapper and grouper in the Gulf Stream "is just not even the same ball game."

And fishing for mackerel: "Everybody's been getting into it. There has been a decline in the king mackerel."

In short, Winner welcomes the regulations—even down to the detailed stipulations on fish traps in the snapper-grouper plan. Winner says fishermen often loose half their traps in a season. "They sit on the bottom and kill fish for years."

He tells of the time in the 1960s when he pulled up a stray trap. The wire mesh box, though finally rotting, had continued to trap fish for quite some time, Winner says. There were live and rotting fish in it at the time and the bones in the bottom of the trap were three and a half inches deep.



Skippy Winner

Key issues

One of the key issues that remains to be resolved in the implementation of the Fishery Conservation and Management Act is whether reliable data on the biological and socio-economic aspects of fisheries can be developed. In determining the optimum yield of a fishery—that is setting the catch quotas—councils must consider all three factors.

But according to Ernie Premetz, executive director of the South Atlantic Fishery Management Council, "First generation plans are very weak in the area of optimum yield development. I think as time goes on that situation will change."

Mandatory catch reports may help. And studies are underway now to provide more information on recreational catches and on the socio-economic factors.

But for now, Premetz says, "What we're having to work with, quite frankly, are some really lousy statistics. And we're having to make the assumption that the fishery is fully utilized and *that* is maximum sustainable yield and optimum yield." Premetz adds "I'm hoping that the National Marine Fisheries Service (NMFS) can begin to provide useful statistics. If they don't we're just not going to be able to manage anything." Ted Rice, director of the NMFS Beaufort Laboratory, acknowledges that the act has made NMFS aware of the data it doesn't have.

While data are being developed, Premetz says, the council is attempting to maintain the status quo in the fisheries until "we can make some meaningful decisions on what will turn the fisheries around. We're trying to get all the information together first before we go willy nilly."

The lack of information also may affect the council's progress. Chuck Oravetz of the National Marine Fisheries Service office in Miami says that among the South Atlantic, Gulf of Mexico and Carribean councils only one plan has so far been submitted for federal approval. But he says, "Some of the other councils have the advantage in that they have historical data that does not exist in the Southeast."

At a South Atlantic council meeting in January, member J. Roy Duggan criticized the group for not making decisions on the billfish plan sooner. Duggan, whose term expires this summer, said "I would hate like hell to have served on a council in which we didn't approve a single plan. . . We've got to determine to get this plan completed. . . It's hurting the whole image of this council."

Fishing on "the inside"—the sound

Council chairman Ben Hardesty responded in an interview later that the council has needed time to get set up. "I think most of us are trying to do the best job we can with what is available to us. I for one would like to see these plans come on stream faster, but when you consider that there are seven national standards that we have to consider for each and every one of these plans and there are other laws and restrictions confronting the councils, this is why that long time span."

Implementation of the act also has pointed up the need to manage those species—such as striped bass, menhaden and shrimp—which range from state to state in the territorial sea. FCMA applies to the area from three to 200 miles out at sea. The territorial sea is the three-mile stretch adjacent to the shore where states have jurisdiction.

Already there are interstate fisheries commissions, but council member Ed McCoy of the N.C. Division of Marine Fisheries says those commissions do not have the legal clout to carry out their plans. Consequently, efforts are being made in Congress to strengthen that system. McCoy says he is hopeful that such a bill will be enacted. While he agrees on the need for such a bill, Premetz suggests that the economic climate isn't too promising for yet another set of commissions.

THE BACK PAGE

"The Back Page" will become a permanent part of this newsletter's new look. This is where you can read about what's new in Sea Grant activities—in research, marine education, and advisory services. Check this page for new publication listings, too. For more information on any of the projects described, call the Sea Grant office in Raleigh (919/737-2454).

Sea Grant researcher Peter Fricke of the Institute for Coastal and Marine Resources and the Department of Anthropology and Sociology at East Carolina University (ECU) has begun a series of interviews with recreational fishermen along the North Carolina coast. His study is part of a larger effort to learn more about the recreational fishery off North Carolina.

Recreational fishing is an important activity along the state's coast. Its popularity is growing by leaps and bounds. On a typical sunny summer day, marinas and piers bustle with activity; thousands of small boats troll sounds and nearshore waters, and surf fishermen eagerly line up along breakers in pursuit of prize catches.

For the hundreds of businesses that have developed around the recreational fishing industry such growth has been a real boon. But it has also intensified pressures being placed on finite fishery resources and fueled the growing controversy between commercial and recreational fishing interests.

Specifically Fricke's study is focusing on the socio-economic characteristics of the small boat recreational fishery for pelagic species, including king and Spanish mackerel, bluefish and false albacore. The National Marine Fisheries Service estimates that this segment of the recreational fishery has doubled in the last two decades.

Through a series of interviews with recreational fishermen, Fricke hopes to find out such information as: who participates in the recreational fishery and why, how much value they place on the fishing experience, how much money is generated by the fishery, the frequency and duration of fishing trips, what species of fish are being caught and how they are used, what effect recreational fishing is having on fish stocks, and what impact regulatory policies will have on the fishery.

This information is basic to fishery management plans being formulated by state resource agencies and by the regional councils under the Fishery Conservation and Management Act.

With the help of Sea Grant funds, three graduate researchers at the University of North Carolina's Institute of Marine Sciences in Morehead City will be looking at the effectiveness of grass transplants in revegetating sea grass meadow areas damaged by boating and shellfish harvesting activities.

The grasses that grow in estuarine and nearshore environments provide valuable habitat for many commercially important fish and shellfish. They also form the basis of the food web upon which many marine organisms depend.

Unfortunately these grasses are easily disturbed by the activities of man. Shoots are easily broken off and entire plants uprooted by whirling propellors, shellfish dredges and clam kickers. In nature it may take years for a damaged area to recover.

But researchers Mark Fonesca, Jurij Homziak and W. Judson Kenworthy believe that it may be possible to shorten the recovery time by using grass transplants. In this project they will try to transplant sea grasses into a 3.2 hectare site in Back Sound, southeast of Cape Lookout. Commercial scalloping activities in the area have completely denuded the site of eel grass cover. The researchers will monitor the area to see how well different grass mixtures work and what sort of changes occur in populations of fish and shellfish as the area revegetates. If the experiment is successful, it could become an important management tool for the restoration of damaged areas.

Coastal recreation is a subject that appeals to inlanders as well as coastal residents. So for the past two springs Sea Grant's recreation specialist Leon Abbas has presented a series of lectures in Raleigh on coastal recreation. This year the series also will be presented in Charlotte. It will run four consecutive Monday nights in the North Carolina State University Faculty Club on Hillsborough Street in Raleigh and four consecutive Tuesday nights in the auditorium of the Best Western Coliseum Motel, 3024 East Independence Blvd., in Charlotte. Lectures will begin at 7:30 p.m. and are open to the public free of charge. Here's the schedule:

Pier and surf fishing in North Carolina, Robert Goldstein of Raleigh, author of *Pier Fishing in North Carolina*. March 19 in Raleigh. March 20 in Charlotte.

Sharks, Frank Schwartz of the Institute of Marine Sciences in Morehead City. March 26 in Raleigh. March 27 in Charlotte.

Shelling on North Carolina beaches, Hugh Porter of the UNC Institute of Marine Sciences in Morehead City. April 2 in Raleigh. April 3 in Charlotte.

Getting started in family boating, J. Rodney Hall of Rock Hill, S.C. April 9 in Raleigh. April 10 in Charlotte.

Also on the recreation front Sea Grant agent Dennis Regan has a hand in planning a one-day statewide scuba conference. The meeting will be held at the Marine Resources Center on Bogue Banks and will treat various aspects of diving in North Carolina—from under-

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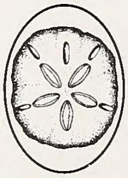
water photography to submarine armament. Regan says the workshop will be open to interested divers and dive shop owners. The final date hasn't been set, so watch "The Back Page" for further information or call Regan (Marine Resource Center/Roanoke Island, 919/473-3937).

Supplemental funds were recently awarded to biologist Don Kapraun of UNC-W to continue studies started last year on the feasibility of establishing a nori harvesting industry in southeastern North Carolina. Nori, a lettuce-like marine algae, is cultured and harvested in the Orient where it is used extensively as a seasoning and protein supplement. A similar species of nori (*Porphyra sps.*) is also found growing on oyster reefs in shallow tidal creeks along the southeastern section of the state.

In earlier studies supported by Sea Grant, Kapraun discovered that the unique reproductive pattern of the algae meant that as many as three crops could be harvested during a single growing season. He also found that the nutrient content of the plant (37 percent protein per dry gram) rivaled that of even the most expensive, grade A variety produced in Japan.

Kapraun believes that it may be possible to commercially harvest nori during late winter and early spring, providing North Carolina fishermen with a "back-up" industry. With the additional research support, he will look at the standing crop of the algae in North Carolina and determine its cash value. Nick Williamson of the International Trade Center at Research Triangle Park will study the supply and demand for nori as well as price levels on both domestic and foreign markets. Because the algae thrives in polluted waters, the researchers hope that nori taken from such areas still will be safe for human consumption. As part of the study, Marvin Speck of North Carolina State University (NCSU) and Louis Adcock of UNC-W will test for bacterial, viral and heavy metal contamination of nori taken from waters closed to shellfishing.



Coastal resources and problems will be the subject of two-day marine social studies workshops later this month and in April. Secondary social studies teachers will review the one-semester high school course which introduces the coastal environment and its multiple uses. Also included in the course are the conflicts and political solutions surrounding the use of the coastal zone.

Sea Grant's education specialist, Lundie Mauldin, is helping to put the workshops together. Teachers interested in signing up may contact John Ellington at the Division of Social Studies in the N.C. Department of Public Instruction. Workshop dates are: March 29-30, at the University of North Carolina at Wilmington; and April 5-6 at the College of the Albemarle, Elizabeth City. Workshop sponsors are the Office of Coastal Management, the Office of Marine Affairs, UNC Sea Grant and the Division of Social Studies.

Severe deterioration is occurring in asbestos cement bulkheads located in coastal North Carolina. Jerry Machemehl, NSCU, has determined that the failures occur in estuarine areas where the waters are acidic and contain high levels of dissolved carbon dioxide. A report describing the field and laboratory work and outlining the causes for asbestos cement sheet failures is available from Sea Grant, Box 5001, Raleigh, NC 27650. Ask for Working Paper 78-1. It's free to North Carolina residents; out-of-state charges are $4.00.

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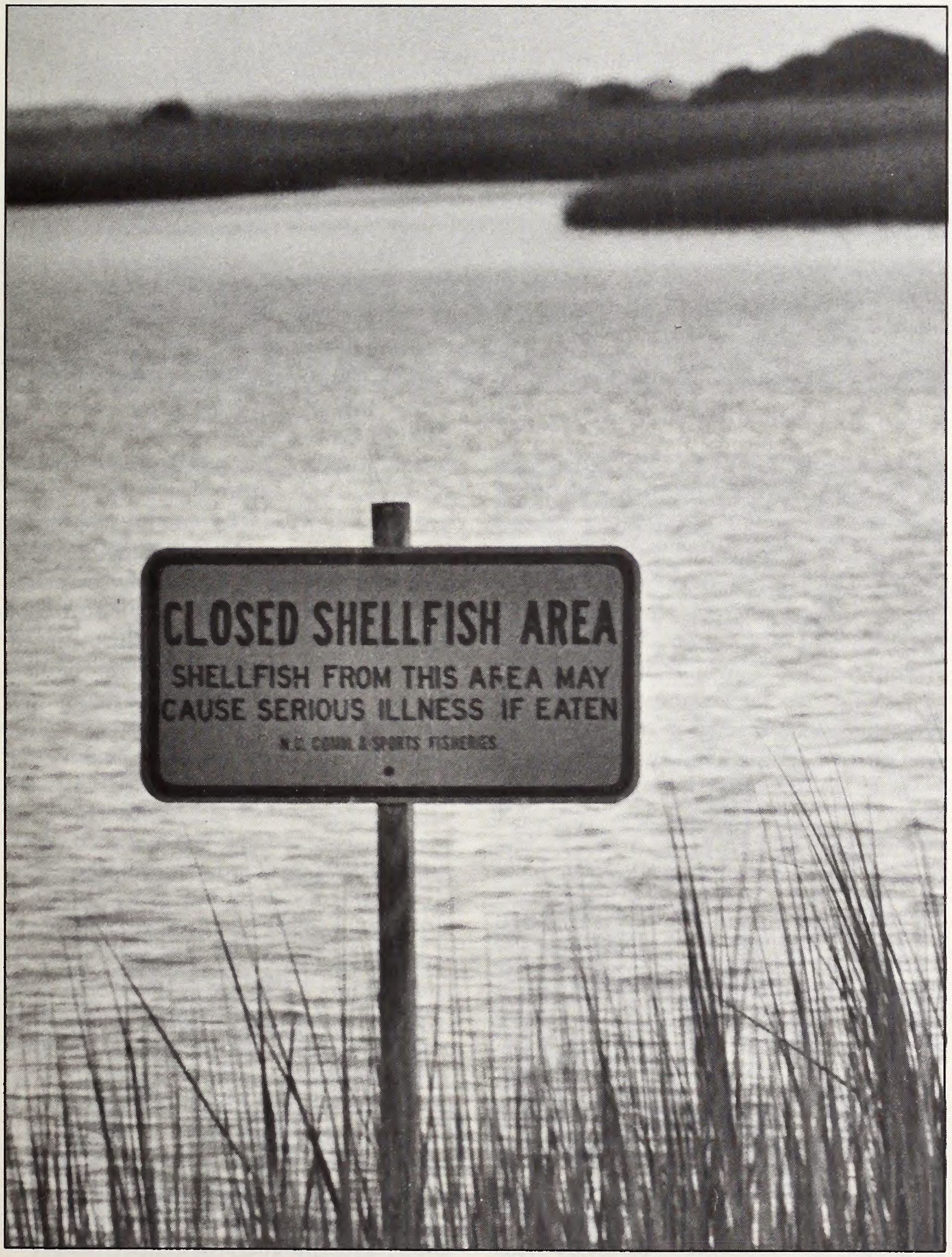
Septic tanks - a lesson in designing with nature


CLOSED SHELLFISH AREA
SHELLFISH FROM THIS AREA MAY
CAUSE SERIOUS ILLNESS IF EATEN
N.C. COMM. & SPORTS FISHERIES

Septic tank pollution—how much of a threat?

The rain had finally stopped. As David Spencer walked around the puddles in his yard the grass beneath his feet squished like a wet sponge. Down the road his neighbor's property looked the same—water-logged.

"All the land around here has clay in it," Spencer explained. He pointed to his backyard, "You could dig a hole there and put water into it and the water will just sit there until the sun dries it up."

Four years ago when Spencer bought the land in coastal Hyde County he didn't think much about the clay in the soil or the fact that the water table lies less than two feet below the surface. At the time the local sanitarian had assured him that there would be no problem in using a septic system on his land.

But last year when Spencer applied for a building permit he discovered that everything had changed. Under new state disposal regulations he could not use a conventional septic system because his land did not have the proper permeability or adequate separation from the water table. With Germantown Bay only 175 feet from the site, the county sanitarian had little choice but to turn the application down. Unless Spencer could install an alternative system, he would not be allowed to develop the property.

Spencer's story is not unusual. More and more property owners in coastal North Carolina are discovering that poor soil conditions and high water tables make safe disposal of septic wastes a major issue. Though the source of the problem varies from location to location—ranging from coarse

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sands, high water tables, muck soils and clayey subsoils—the result is the same. New development is stunted, while older, more established areas experience the growing aggravation and expense of failing septic systems.

Search for alternatives

For more than three years UNC Sea Grant researcher Bobby Carlile of North Carolina State University has been studying on-site septic waste disposal in the coastal zone. According to Carlile the disposal dilemma of coastal North Carolina typifies that facing many other rural coastal states. He compares it to the proverbial rock and a hard place. On the one hand, in many areas the state's coastal population is too sparse and seasonal to support centralized sewage collection and treatment. On the other hand, unsuitable soils and high water tables often make it difficult to find sites where conventional on-site disposal systems will work.

But effective, low cost alternatives to sewers and septic tanks are available. Researchers have found that the basic septic system design can be modified and improved so that it will work under a variety of conditions. With Sea Grant support, Carlile has been experimenting with these alternative systems and modifying them for use in coastal environments.

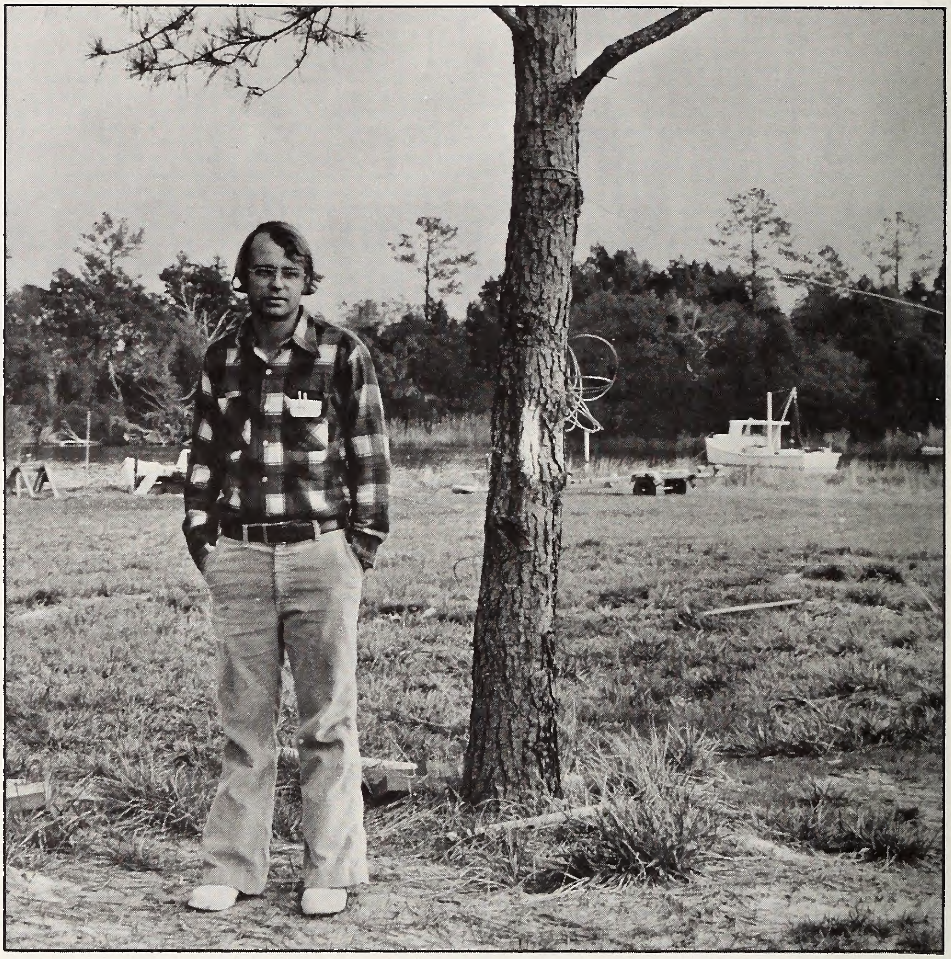
Critical timing

Along the coast his research has borne fruit at a critical time. Two years ago new regulations were issued putting more "teeth" in the state's Ground Absorption Act. Soil permeability criteria were defined and setback and separation standards were established. The result—septic waste disposal became an explosive issue throughout the coastal zone. In Hyde County alone more than 50 percent of the applications for septic tank permits were rejected over a 14-month period.

"We were almost at a standstill," recalls Clifford Swindell, Hyde County manager. "Our contractors were complaining. The people who lend money were complaining. And the people who wanted to develop their lands were complaining . . . Under the new regulations we just couldn't fit in."

"We were fast reaching the crisis stage," adds County Commissioner Eddie O'Neal.

For Carlile the conditions in Hyde County provided an ideal testing ground for many of his modified systems. Several experimental systems already had been installed in Hyde County and elsewhere. And, after a series of meetings with officials from the state Department of Natural Resources and Community Development and the Department of Human Resources, the county Board of Health was given the go-ahead to use Carlile's systems wherever conventional ones wouldn't work.



Spencer: clay soils, high water tables and building headaches

Though skeptical at first, David Spencer knew that a modified system was the only option he had if he wanted to build on his land. Following the lead of his neighbor, Meredith Cook, Spencer agreed to have Carlile install a low pressure distribution system on his property.

At both Cook's and Spencer's sites local contractors, developers and health department officials were invited to watch the installation process and learn more about the system's operation. Monitoring wells were constructed at the sites so that the researchers could keep tabs on ground water quality in areas adjacent to the systems.

After nearly two years Meredith Cook is convinced that Carlile's low pressure system is the only disposal technique that will work on his property. "It's used the heaviest in December and January, which are also the wettest months, and I've never had any problems," he says.

Though Spencer's system is only six months old, he too is pleased with its performance. "It's probably the best system around here. To use a conventional system I would have had to dig up most of my yard and it would have cost a lot more."

The bail out

Today the septic tank issue has quieted in Hyde County. Local health officials credit much of the improvement to Carlile and his modified systems. Last year 13 sites that would have been rejected under conventional septic treatment were approved for low pressure distribution systems. "You might say the systems bailed us out," says Swindell.

"People now are more aware of the restraints on where they can build," adds O'Neal. "They don't just go out and buy a piece of land and then worry about getting a permit for a septic tank."

Throughout North Carolina the news of Carlile's work is spreading fast. In the last three years more than 100 low pressure distribution and 10 mound systems have been installed under his supervision in 11 coastal counties. Dozens more have been installed by contractors and individual homeowners who have found out about the systems at workshops led by Carlile.

"We've been able to use so-called marginal lands that otherwise we'd have no choice but to turn down," observes Craven County Sanitarian Al Harris. "The alternative systems allow us to have economic growth and yet we're still protecting the environment."

The density threat

In recent months Carlile has focused his attention on the southern section of the coast where dense populations pose the most serious problem.

"We're projected to be a major growth area in North Carolina," explains New Hanover County Sanitarian Frank Olive. "More growth means more homes and more homes mean more septic tanks and increased potential for pollution. You get the domino effect."

Although the city of Wilmington has a centralized sewage system, outlying unincorporated areas in New Hanover and Brunswick Counties currently rely on on-site disposal methods. As in many coastal areas, sites suitable for conventional septic systems are few and far between.

"Most of our lots are requiring some sort of modification," says Olive. Typically this involves such remedial measures as drainage, back filling and modified trenching. But on some sites this isn't enough. It is in these areas that Olive thinks Carlile's work could have the greatest impact.

So far two low pressure and one mound system have been installed in the county. While it is still too early to tell if the systems will work there, Carlile, Olive and many local contractors and developers are keeping a watchful eye on their performance.

Despite the success of his work in coastal North Carolina, Carlile is the first to emphasize that the systems are not a panacea to septic waste disposal problems in all rural areas. "Some people get the idea that with alternative systems you can build in the marsh," he jokes. "The fact is that we're still looking at sites that are unsuitable and can't be developed."

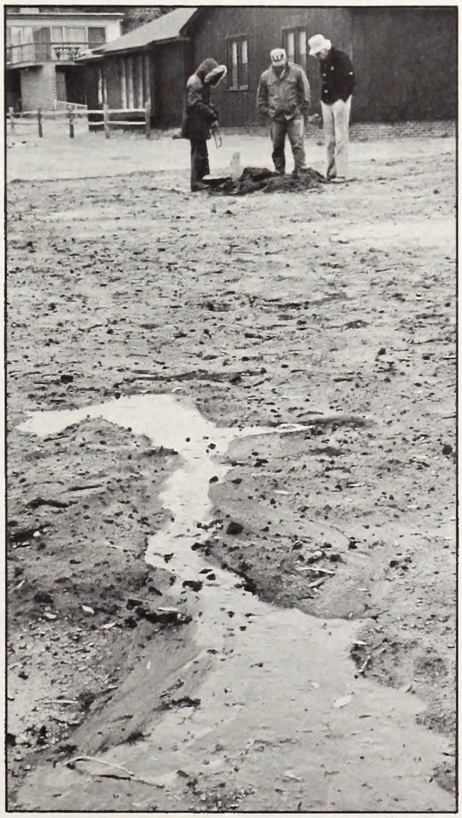
Maintenance needs

One of Carlile's chief concerns is the fact that modified systems require more maintenance than conventional ones. "The old conventional system, when it's working right, is the most maintenance-free system available," he says.

With modified systems pumps must be inspected regularly, distribution lines checked and tanks pumped out before they fill with solids. "A homeowner has to be aware of what the system is, how it works and what routine maintenance is required," he stresses. How well an alternative system works, Carlile warns, ultimately depends on how mindful a property owner is of routine maintenance needs.

New twists to an old design

There's nothing new about the septic tank. In fact it's one of the oldest systems of waste treatment. It was first introduced to this country nearly a century ago and, for the most part, has remained relatively unchanged. Today in North Carolina there are more than two million septic tanks in operation with an estimated 50,000 more being added yearly. Nationally, 85 percent of the individual, on-site waste disposal systems rely on septic tanks and cesspools.



When theory breaks down

In a nutshell, the septic system takes advantage of the soil's natural filtering properties. Wastes are channeled from the house into a holding tank where solid portions settle out at the bottom of the tank as sludge. Although anaerobic bacteria in the tank digest or breakdown much of the sludge, residual solids accumulate and, from time to time, must be pumped out and disposed of—either at a treatment plant or land application site.

The liquid portion of the waste or effluent flows out of the tank and travels along a series of pipes into a specially designed absorption field. In the absorption field the effluent slowly seeps through the soil. The soil acts like a huge filter, trapping solids and absorbing dissolved contaminants in the effluent. These trapped materials, in turn, are nourishment for tiny organisms growing in the soil. By the time the effluent has traveled through the various soil layers and reaches ground water it has been thoroughly treated.

At least in theory that's how a septic system operates. But not all soils act the same way in filtering effluents. Sandy soils, for example, have such large pore spaces between the soil particles that the effluent may rush through the absorption field without being filtered.

By contrast, tight soils with high clay content can be so dense that they are impermeable. The result—untreated wastewater collects or ponds on top of the impermeable layer and can surface.

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According to Soils Extension Specialist Bobby Carlile of North Carolina State University these poor soil conditions are not restricted to a single geographic area. They can be found just about anywhere. Along the coast these conditions are confounded by the presence of high water tables. And from Carlile's perspective, that's where the real headaches begin for waste disposal.

Confounding the issue

"When you try to put sewage in ground with a high water table, it's just like trying to put water into a jug that's already full," he explains. "You don't get the degree of treatment that you have in aerated soils."

Carlile estimates that in many areas of coastal North Carolina nearly 90 percent of the soils are unsuitable for conventional septic systems. Nationally, the United States Environmental Protection Agency estimates that as much as one-half of the soils are unsuitable. Faced with those grim statistics, property owners in the past have had little choice but to invest in expensive chemical treatment units or drainage systems or simply sell their land. But Carlile believes that this isn't always necessary. In many instances the homeowner or developer can install a modified septic system that will work where a conventional one won't, and at only a slightly higher cost. The key he says, "is to make the system fit the site."

And that's exactly what Carlile has been doing over the past three years with UNC Sea Grant. To date his two most successful designs involve a low pressure distribution system and a mound system.

The low pressure system

The low pressure distribution system utilizes the natural soils at the site. In theory it is nearly identical to the conventional septic system except that a low pressure pump enables the effluent to be distributed more efficiently and uniformly over the entire soil absorption area. Distribution is accomplished by pumping the effluent under low pressure through a network of small diameter, perforated PVC (plastic) pipe. In addition, the pumping station doses or limits the amount of effluent entering the field at a given time. The combined effects of better distribution and dosing help prevent the soil in the absorption field from becoming clogged and saturated. Because the soil is then able to "dry out" and re-aerate between doses, the level of effluent treatment is improved.

In the conventional system, the force of gravity moves the effluent through the system and the overall orientation of the system must be downhill. Unfortunately, in low-lying areas typical of the coastal plain, such sites are rare or often located dangerously near sources of ground and surface water. With the low pressure distribution method a pump rather than gravity is used to move wastewater through the system. Distribution lines do not have to be placed as deeply in the ground, and, if necessary, the effluent can be pumped upward, away from water tables and into better soils.

Carlile estimates the cost of the typical low pressure system at between $1,200 and $1,500, about 25 percent more than a conventional septic system. But it requires virtually the same amount of land as a conventional absorption field.

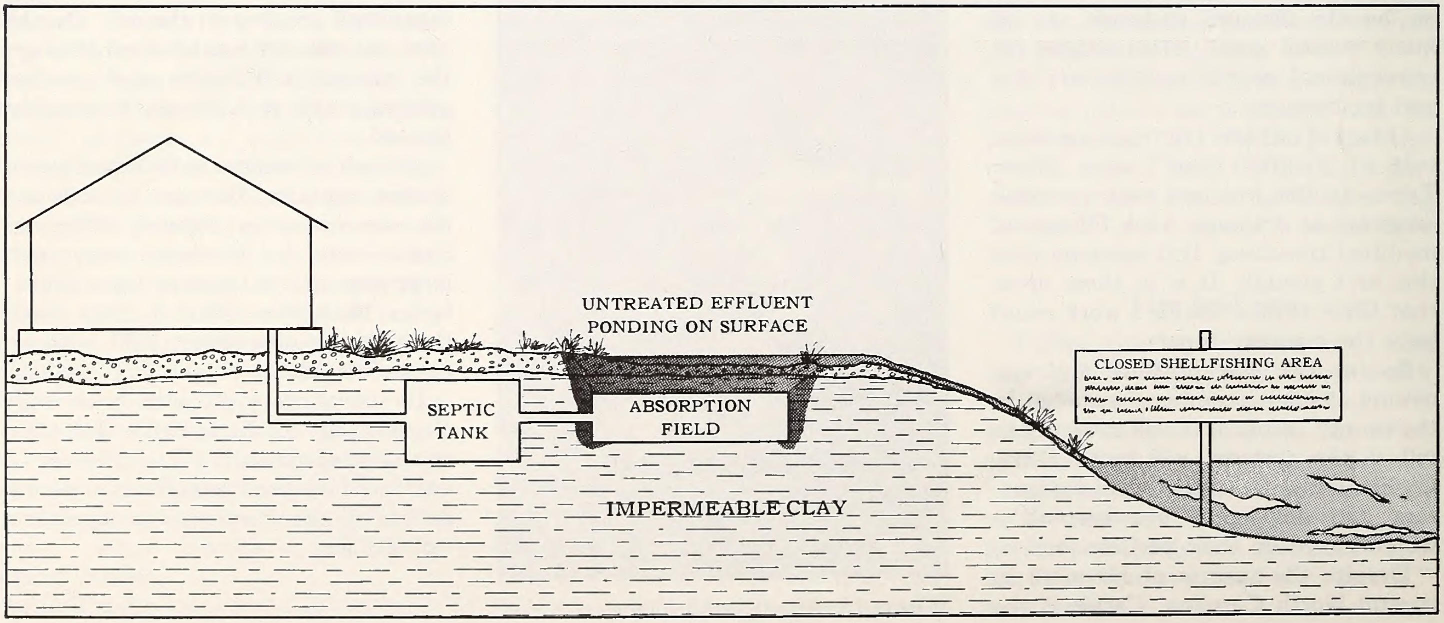
The mound system

The mound system is another modified system that Carlile has worked with. Because an essentially "artificial" system must be built, he considers the mound technique "a last resort" for areas where natural site and soil conditions are extremely poor.

In this system the absorption field is constructed above ground in a soil mound. The mound itself is a layered hill of loamy fill, gravel and sand which effectively treats the wastewater before it reaches the natural soil surface. A low pressure system is placed inside the mound to ensure that the effluent is evenly distributed.

The one drawback to the mound system is its cost—nearly double that of the low-pressure system, depending on how far the fill material must be transported. Despite the high price tag, Carlile believes it is one of the least costly alternatives for property owners faced with particularly troublesome sites.

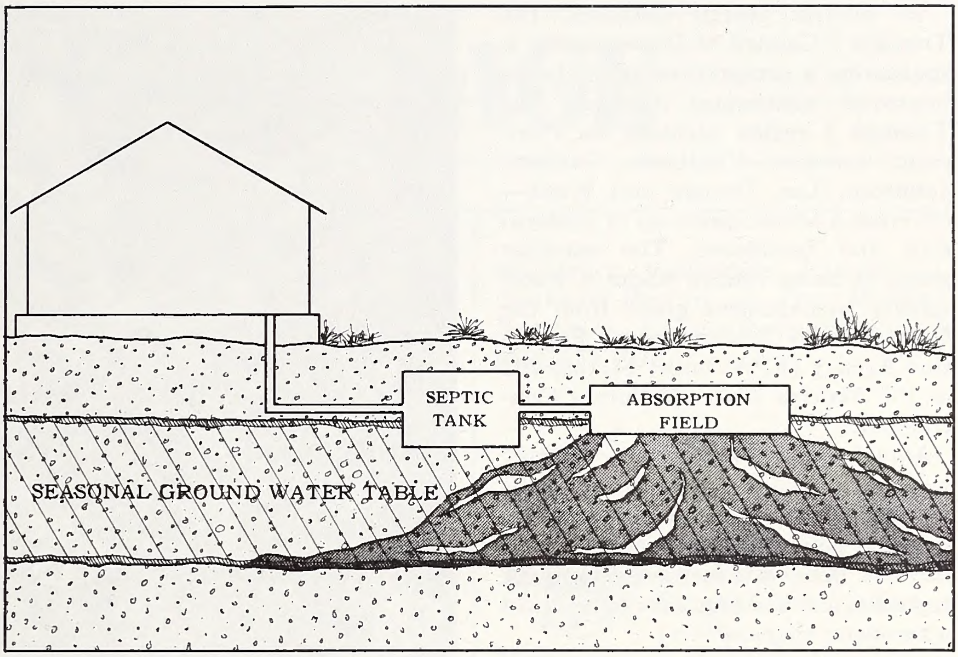
While the alternative systems are



still considered experimental, regulations issued under the state's Ground Absorption Act now recognize the right of property owners and developers to use these systems on problem sites as long as they can be proved effective. Similar regulations are in effect in other states.

State of the art

For Carlile these rulings have been an important boost to his work. According to Steve Steinbeck with the North Carolina Department of Human Resources' Division of Health Services, they open the way for more and more breakthroughs in the area of alternative on-site waste disposal. "Systems such as low pressure distribution are fast becoming the state of the art instead of experimental," he says.



Studies probe the basics of septic waste disposal

Beyond the issue of disposal system design and maintenance there are still many questions that need to be answered about on-site waste disposal in general. In addition to the Sea Grant project, several other studies are being conducted in North Carolina. A special state task force has been formed to address the issue of alternative sewage disposal.

One important area of research concerns the effectiveness of alternative systems in filtering contaminants. As part of the Sea Grant study, microbiologist Mark Sobsey of the University of North Carolina at Chapel Hill is studying the effectiveness of the low pressure and mound systems in removing bacteria and viruses in wastewater. Viruses are particularly difficult to filter out because they are so small and can rapidly migrate through pores in the soil. At several study sites, Sobsey is assaying waters from special observation wells and surface waters adjacent to the alternative systems.

In addition, a network of 168 monitoring wells has been set up along the coast in 11 counties to determine the extent of water table fluctuations both tidally and seasonally. This information is important for designing the disposal systems and in refining septic tank regulations.

One of the biggest concerns along the coast has been the impact of pollution from poorly treated wastewater on shellfishing waters. Last year more than 400,000 acres of clam and oyster waters were closed to harvesting in North Carolina. While Bob Benton of the state's Shellfish Sanitation Division believes that "septic tanks play a significant role in the closure of these areas," he is unable to quantify "significant."

Bridging the gap

"There are so many other factors," emphasizes Charlie Jackson with the Shellfish Division, "that we can't make a blanket statement." Runoff from industry, farming operations and even the natural decay of plant and animal material contribute to the closure of shellfishing waters.

According to Steve Steinbeck with the Division of Health Services the connection between septic tank pollution and shellfish contamination has never been clearly demonstrated. "There's been a lot of innuendo, but the data is not conclusive. We'd like to have some good hard evidence," he explains.

In an effort to answer some of the more basic questions about wastewater contamination, the Coastal Plains Regional Commission recently awarded an $80,000 research grant to the North Carolina Department of Human Resources' Division of Health Services. According to Steinbeck, who is the project director, the focus of the research will be on determining the fate of contaminants and nutrients typically found in wastewater as they move through the soil. Both Carlile and Sobsey are participating in the study.

The research project will involve detailed monitoring of conventional and modified septic systems in Hyde, Craven and New Hanover counties. These counties, Steinbeck explains, were selected because they represent a range of soil problems, "from very well drained soils to muck soils, from organic soils to hard pans."

Steinbeck believes that the results of the study will be important in shaping future septic disposal regulations and in providing researchers with an opportunity to quantify the role of soil and ground water characteristics in wastewater treatment.

Beyond the coast

The problem of on-site waste disposal isn't limited to coastal North Carolina. Problem soils and high water tables extend across state borders and beyond the coastal plain into Piedmont and mountain regions.

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In central North Carolina, the Triangle J Council of Governments is sponsoring a comprehensive study on improved wastewater disposal. The Triangle J region includes six Piedmont counties—Chatham, Durham, Johnston, Lee, Orange and Wake—covering a broad spectrum of problem soils and conditions. The one-year study is being funded under a water quality management grant from the United States Environmental Protection Agency (EPA) under Section 208 of the Federal Water Pollution Control Act.

David Reynolds, project director with Triangle J, describes the study as a combination of research, demonstration and public education. It is unique, he adds, because it focuses on both the technological and regulatory aspects of wastewater disposal.

Dual approach

In one part of the study researchers with the Institute of Government at the University of North Carolina at Chapel Hill are analyzing existing septic regulations to see how they affect the use of non-conventional disposal systems. On the basis of the systems' maintenance needs, they will devise model management programs. In addition, Carlile and others with North Carolina State University's Soil Science Department are looking at the performance of alternative disposal systems. County government and health department officials are cooperating in each segment of the study.

As part of their preliminary work, the study team conducted an overview on septic tank problems and uses in the six-county region. The team identified the various alternative systems available, ranging from rejuvenated septic tank systems to non-conventional systems, and evaluated them on the basis of design, cost, operation and maintenance needs.

Demonstration systems were installed at different problem sites in each of the counties. To date, 25 modified systems have been installed in private homes and at small businesses. They include such techniques as the mound system, low pressure distribution system, recirculating sand filter, spray irrigation system and a conventional system using V-shaped ditches and cross-trenching.

Carlile (top) and assistant Kent Messick inspect pump housing

Currently work is being done to develop a three-acre demonstration facility adjacent to the municipal sewage treatment plant in Durham County. When completed the facility will enable researchers to compare the effectiveness of the various disposal systems under controlled conditions. Raw sewage will be taken from the treatment plant and placed in a series of septic tanks. Effluent from the tanks then will be run through the various systems and the levels of treatment compared.

Carlile is especially enthusiastic about the demonstration project. Not only will it serve as an educational facility for local contractors, engineers, health officials and interested property owners, but it will provide a valuable research center. "It will allow us to get some really hard and fast data for comparison of the alternative systems," says Carlile.

State-wide efforts

On a state level, alternative on-site waste disposal has become a priority issue. Last year an ad hoc Alternative Sewage Disposal Task Force was created in an effort to bring together information on waste disposal problems throughout the state. The task force is comprised of representatives from state and local government agencies, university researchers and concerned citizens.

Anne Taylor, special assistant with the state Department of Natural Resources and Community Development was instrumental in getting the organization started. According to Taylor the primary reason for the task force was to get resource people from across the state together and to find out who was doing what and where.

"We realized that the state had tremendous capability in the area of septic waste disposal but it was spread throughout so many departments and universities," she said. "We were a leader in research but not in using what we had."

Up until now the role of the task force primarily has been advisory; reviewing waste treatment plans and setting up educational programs and workshops on alternative disposal systems. But a recent 208 grant from EPA should help the organization begin to formalize its work.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about upcoming meetings and workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

To momick. It's not a verb you'll find in Webster's. But any Harkers Islander can give you its definition. In the "down east" dialect of Carteret County, it means to tear up or render useless. And here's another: ever heard of a paiser? On Harkers Island it's another word for porch.

Anthropologist Marcus Hepburn is intrigued by these little gems in the language of the residents of this relatively isolated island. He's been studying the linguistics, folklore and general way of life of the islanders since he moved to Harkers Island last spring. Hepburn is working with anthropologist Jim Sabella and sociologists Richard Dixon and Roger Lowery of the University of North Carolina at Wilmington (UNC-W). With Sea Grant funding, they're looking at Harkers Island as an example of a traditional boat building and fishing village. They hope that the information they collect will help planners and fisheries management officials to make decisions that are compatible with traditional lifestyles on the island.

Clams are an important fishery resource in North Carolina. When catches of other, more valuable shellfish are down, fishermen often turn to hard clams for supplemental earnings. But a combination of two extremely cold winters and an increase in clamming activity has fisheries biologists worried over the fate of North Carolina's hard clam population.

In an effort to learn more about the population dynamics and biology of the hard clam, Sea Grant researchers Charles Peterson and Richard Deriso of UNC's Institute of Marine Sciences in Morehead City are developing a clam sampling program in coordination with the state Division of Marine Fisheries (DMF). As part of the study the researchers will evaluate the reliability of using growth lines on the clam's shell for aging. The effects of mechanical harvesting on clam populations and the surrounding environment also will be examined.

In another study sponsored by Sea Grant, Deriso will assist the DMF in designing and implementing various sampling programs and techniques for fish stock assessment and population dynamics studies.

North Carolina is becoming a popular vacationland for SCUBA divers; the drawing card—the hundreds of shipwrecks strewn along the state's coast.

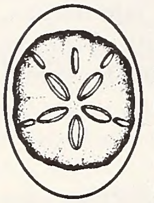
To help diving enthusiasts learn more about SCUBA diving off North Carolina, Sea Grant is sponsoring a free SCUBA conference on May 26 at the Marine Resources Center on Bogue Banks beginning at 9 a.m. Sea Grant agent Dennis Regan says the day-long conference will touch on a variety of topics. J. C. Jones of the Office of Marine Affairs will talk about World War II submarine wrecks and the controversy over torpedo disarmament. John Newton of the Monitor Foundation will present an update on efforts to recover the ironclad Monitor. Captain Ed Wolfe of Wrightsville Beach will discuss safety aspects of diving from charter boats. To help divers identify some of the fish they see, Steve Ross of the state Division of Marine Fisheries will talk about marine fish common to North Carolina waters. Bill Lovin, author of *Wreck*, will discuss underwater photography techniques. For conference registration information, contact Regan at the Marine Resources Center/Roanoke Island (919/473-3937).

How effective are sand bag groins in erosion control? It's a question that's never been answered in North Carolina. But Sea Grant researcher Jerry Machemehl of North Carolina State University (NCSU) thinks that a massive erosion control project along the west end of Long Beach, North Carolina, may provide an ideal testing ground.

Construction of the sand bag groin system was begun last month by the state's Office of Public Works in an effort to reduce shoreline movement in the vicinity of Lockwoods Folly Inlet. The area is experiencing severe shoreline erosion. With support from Sea Grant, Machemehl will look at both the long- and short-term effects of the groin system, how it responds to wave and current conditions and the benefit to cost ratio of the project. Sea Grant's coastal engineering specialist, Spencer Rogers, is assisting in the project. The results of the study could be important in determining whether the relatively low cost system can be successfully used in other locations.

Off-road vehicle (ORV) use has been stirring up quite a controversy along North Carolina's beaches. Sea Grant researchers Paul Hosier and Tom Eaton of UNC-W hope to find out what impact ORVs have on the beach environment. Preliminary results at a study site near Fort Fisher indicate that sand is churned up and vegetation is reduced where ORVs are used frequently.

This summer the researchers will expand their studies to include sites in the Cape Hatteras National Seashore. They've marked off test sites near Oregon Inlet, where ORV use is the heaviest in the park; near Cape Point on Hatteras Island; and at another site on Hatteras Island. The researchers will compare differences in beach profile, sand transport and vegetation on ORV-impacted beaches and sites closed to traffic.



Sea Grant's new continuing education program for fishermen got off the ground last month with two evening classes on trouble shooting and preventive maintenance for outboard motors.

The class is the first of many to be sponsored under the new program. Continuing education coordinator, Wayne Wescott of Manteo, says future short courses will cover safety aboard ship, federal financial aid for fishermen, forming business associations and free U.S. captain's license training. For more information on the program, Wescott can be temporarily reached at the Marine Resources Center on Roanoke Island (919/473-3937).

In other education news, Sea Grant's Marine Education Materials System (MEMS) is coming to North Carolina. Sea Grant's marine education specialist Lundie Mauldin of NCSU has arranged for the microfiche collection of marine education documents to be housed in the Education Information Center of the North Carolina Department of Public Instruction.

A catalogue listing accession numbers for the microfiche is available from UNC Sea Grant for $5.00. Orders for the catalogue including checks payable to UNC Sea Grant, may be sent to Sea Grant, Box 5001, Raleigh, NC 27650. A complete set of the MEMS documents will be housed in the D.H. Hill Library on the NCSU campus.

Though we're only four months into 1979, the wheels already have been set into motion for next year's Sea Grant program. But before any projects are funded, they must undergo a series of reviews by both the UNC Sea Grant administrative staff and special committees comprised of university researchers and agency personnel from North Carolina and elsewhere.

To give you an idea of the various review steps that the projects must go through, we've included this year's schedule:

June 1—Individual project proposals due at the UNC Sea Grant offices in Raleigh;

June 4-30—Ad hoc, state agency and university review;

July 9-13—Proposals returned to researchers for revision;

July 31—Final project proposals due back to UNC Sea Grant office;

September 1—UNC Sea Grant program proposal due at the National Office of Sea Grant, Washington, D.C.;

September 25-27—Office of Sea Grant review and feedback;

January 1—Project funds awarded.

Lookout update

The days of the famous Cape Lookout Lighthouse are numbered. Citing the enormous expense of protective measures, the National Park Service (NPS) announced early this month that it does not intend to take steps to keep the lighthouse from washing into Barden Inlet.

The February issue of this newsletter described the plight of the lighthouse, which now stands less than 300 feet from the eroding shoreline of Core Banks. At that time several state and federal agencies were considering plans to save the lighthouse. Since it is currently developing the Cape Lookout National Seashore, the NPS was selected as the lead agency in the matter.

The light is still used as a navigation aid. So, if it is washed away, the Coast Guard plans to replace it with a simple metal tower at another location on Core Banks.

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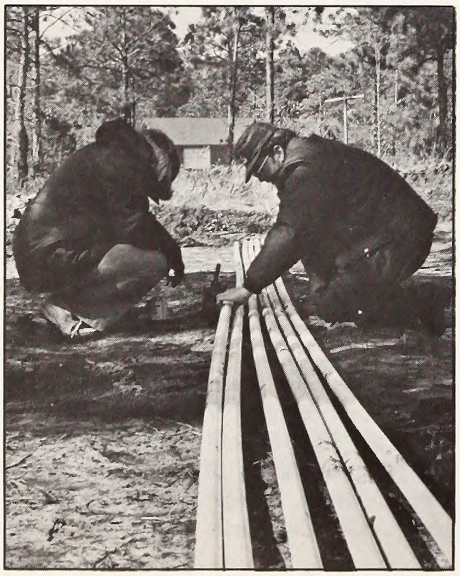

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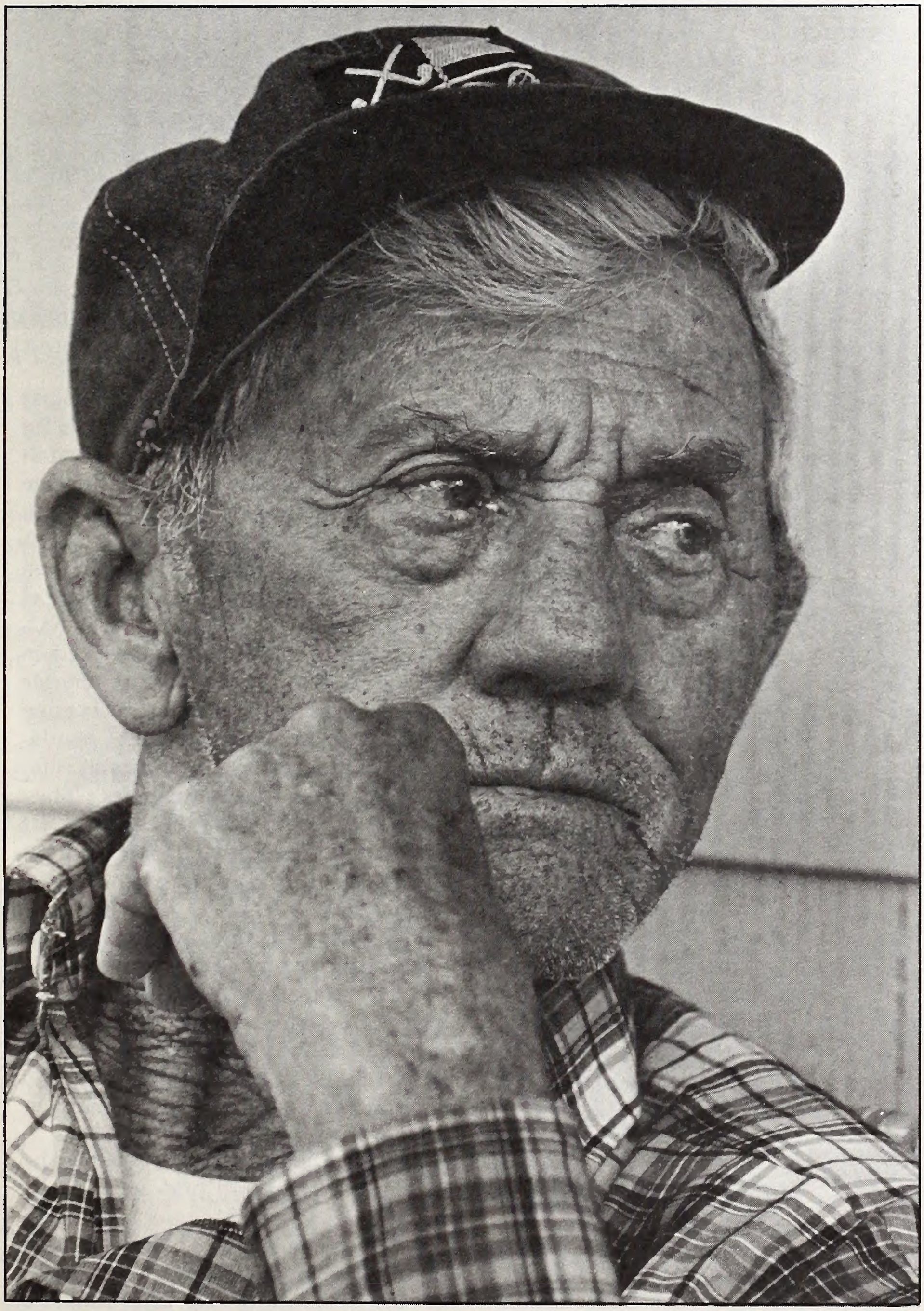


Charlie Russell of Harkers Island

Of corncob pipes And mullet fishing

"When I was a little boy there were about 14 families here. And mostly everybody went barefooted and smoked a corncob pipe or a clay pipe with a reed center. Everybody dipped their snuff like I chew tobacco now."

Charlie Russell's face wrinkled into a grin as he shifted a tobacco wad from one cheek to the other.

A few yards away, traffic on the main road through Harkers Island kept up a steady growl. It punctuated Russell's narrative with motorbike clamor, the swish of recreational vehicles and the rumble of pickup trucks.

Russell paid it no mind. He was busy remembering. "These families lived from one end of the island to the other. Scattered. Nobody here much. And you'd go clamming. You had a little net to go mullet fishing and you'd get 25 cents a bushel for your clams. Now a handful will give you as much as ten bushels would then at the county market."

Charlie Russell is 81 years old. He was born on Harkers Island. So was his mother. Her people came from Diamond City, the little fishing town on Shackleford Banks that was abandoned at the turn of the century.

That geneology makes Russell an "insider" on Harkers Island. He's privy to the unique cultural heritage of people whose lives have for generations depended upon the water. It's a heritage that seems to carry with it rugged self-sufficiency and an uncanny intuition about the forces of nature that rule a seaman's life.

Continued on next page

Russell was a commercial fisherman only a short time before he joined the Navy during World War I. He later worked until retirement at nearby Camp Lejeune. But he can spot danger signs in the weather along with the best of the commercial fishermen. And he keeps a little boat so he can "catch a mess of fish" anytime.

Like many Harkers Islanders Russell has a hard time explaining just how he learned what he knows about the sea. To hear him tell it, you'd think Harkers Island children are born knowing how to dig clams and predict when the mullet are going to run.

As James Rose, a younger fisherman on the island, explains, "if you're raised up in it, then you already know it, just by being around it."

That kind of knowledge has been in the making many generations. It won't die easily. But as Russell's story indicates, other aspects of life on Harkers Island have changed radically since he was a boy. Gone are the maritime forests and swamps that once covered the island. They've given way to well-groomed yards, houses and trailers.

"Used to be if you wanted to get somewhere on the island, you had to walk along the shore," recalls Russell. Today paved and dirt roads crisscross the island.

You'll still find a boat in nearly every yard but commercial fishermen and boat builders make up a dwindling portion of the population. The mail boat which sailed to Beaufort has been replaced by a standard brick post office. In 1926 a ferry service, connecting the island with the rest of Carteret County, began. And since 1941 islanders have been able to drive across a bridge to the mainland.

Researcher Marcus Hepburn chats with islander Louis Hancock

In short, the days of isolation are gone. And along with them went some of the naive notions that lent the island a special charm. Notions like the one islander Charlie Hancock had as a child.

"I used to think, 'I don't know what people eat that live in other places.' I says, 'What do they live on? They don't get oysters and clams.' The water was our living and the water was all of it. I thought you couldn't live unless you had seafood."

Each year Harkers Island draws more sport fishermen who use the island as a jumping off place to get to prime fishing grounds on Shackleford and Core Banks. That has meant the inevitable increase in conflict between commercial and sport fishermen over fishing grounds. Now, with impending development of Cape Lookout National Seashore, more changes seem to be in store. The seashore includes nearby Core and Shackleford Banks; plans call for putting the headquarters on Harkers Island.

For the past year anthropologist Marcus Hepburn has been living on Harkers Island, keeping a close watch on how these changes are affecting the islanders. Hepburn is working on a Sea Grant study with anthropologist Jim Sabella and sociologists Richard Dixon and Roger Lowery of the University of North Carolina at Wilmington (UNC-W). The researchers are interested in finding out how certain predictable factors, such as tourism, increasing population and government regulations, influence the traditional lifestyles of coastal communities. They chose Harkers Island because of its long-standing tradition as a boat building and commercial fishing community.

This spring the researchers surveyed most of the island's adult population to find out about their attitudes toward a variety of issues, such as extended jurisdiction and fisheries management plans. The results should be useful to government agencies and planners in other coastal communities.

Hepburn has also been studying the history of the island and some of its families. He has spent many hours with old timers collecting tall tales and folklore which he considers essential to an understanding of the island's traditional culture.

A boat in every yard is still the rule on Harkers Island

'Sun dogs' and the weather

When folks on Harkers Island discuss the weather, they're not just passing time. Even more than fisheries enforcement officials, the weather controls the commercial fisherman's life. It determines what there is to catch, how much of it and when the fisherman can go out to get it.

Back in the days before living room barometers and television meteorologists, Harkers Island fishermen had to be able to predict the weather. Most of them still can.

According to Marcus Hepburn, who has been collecting weather lore, the fishermen's specialized language describes delicate changes in the sun, moon, clouds, water, wind, tides and the behavior of animals.

It's a far cry from meteorologists' pedantic language. But it's colorful and accurate. In lieu of cirus and cumulus clouds, the fishermen talk about mare's tails, turkle fat and double-headed giants. And they can make the fine distinctions between calm water, slick calm and dead slick calm.

When it comes to wind conditions, Harkers Island fishermen use expressions like Rotten Easter, wind chop and sheep storm. "Smelling the pine tops" is a predictive phrase, usually associated with mullet blows in August. The belief is that if a whispy black cloud passes over the water carrying the odor of pinetops there will be a mullet run soon.

Ever heard of a "sun dog?" It's a tiny multi-colored cloud seen in the evening. "If you see one this evening that side of the sun, you'll have bad weather from that direction tomorrow," says Charlie Russell.

A few Harkers Island weather phrases have a lilting rhythm that makes them easy to remember. Like this one: "When the wind backen against the sky, trust it not for Back Shell run." Or "wind blowing on the change of the moon, it'll rule that way till the moon is full."

The relationship between tide and wind is noted in detail. A north wind, some fishermen say, should keep the tide from ebbing out too far. But with a southwest wind at low tide "just about everything will be ebbed out."

Any Harkers Islander worth his salt can tell something about the weather from the behavior of animals. If you see lightning bugs in the evening, they say, there will not be strong or bad weather the next day. What's more, there will be "fire" or phosphorus in the water that night. They also say that when the horses that still roam Shackleford Banks come off the marsh, there will be bad weather before long.

And here's another Harkers Island favorite: the George Anson. "You get it especially in the month of March," explains Charlie Hancock. "You'll be going in the water and directly something will build right up in the water like a little tornado or something. It don't mean nothing. . . . Directly it will blow right out and go to nothing. I've seen many a one of 'em in my time."

A few of the weather phrases are closely tied to the history of the Outer Banks. "Cold as Crissy Wright times," for example, refers to one of the area's worst shipwrecks. The Crissy Wright, with her crew of eight, ran aground off the coast of Shackleford Banks in the winter of 1905. It was so cold and windy that all but one of the crew froze to death before a rescue team could plow through the rough seas to the ship.

Watch out if you ever hear the expression: "The Lawrences are going to dance." That means it's gonna be a scorcher. It refers to the heat waves which rise from the surface of the earth or street during very hot weather.

Talk about folklore always seems to come around to witches. Like most traditional communities in North Carolina, Harkers Island is reputed to have had its share of practicing witches. Charlie Russell remembers one in particular. "She claimed she had a crooked stick, she could work you, make you give her something."

During his youth, Russell says, there were lots of folks on the island who believed in the witches' powers. When a fisherman had a streak of bad luck, he might blame a local witch who had "put a conjure on him."

The most popular way of breaking the jinx, says Russell, was for the fisherman to make a life-sized drawing of the witch. He then stood the drawing in the yard and fired his shotgun at it. "That was—most any fisherman that had little enough sense to believe it," chuckles Russell.

Diamond City: a town that still grips the imagination

If you hang around Harkers Island long enough, someone will tell you about Diamond City. Like the legendary Atlantis, this defunct nineteenth century community seems to take a grip on the imagination.

Until 1900 Harkers Island was a no man's land. No more than a dozen families lived there. But across the sound on Shackleford Banks were several flourishing communities, bearing poetic names like Edge of the Woods, Sam Winsors Lump and Mullet Pond. Their populations totaled about 500.

Just east of the Cape Lookout lighthouse was Diamond City, one of the largest of these settlements. It took its name from the diamond shaped pattern painted on the lighthouse.

Harkers Islanders like to boast that at one time Diamond City was the third largest community in Carteret County—"back when Morehead City wasn't even thought of." Some of them were born in Diamond City and many can trace their ancestors back to this little fishing and whaling community.

Another era

Today Shackleford Banks looks like a dubious location for a settlement. A narrow, rugged island covered with dunes, it supports only marsh grass. No one lives there year round. But during the first half of the nineteenth century the island was practically covered with cedar pine and oak. Cattle and horses grazed on lush grass. Settlers planted gardens and grew fruit trees.

But between 1850 and 1900 a series of storms changed the face of Shackleford Banks. The storms swept across the island, killing trees and infiltrating the soil with salt water. Finally, wells began to dry up and the island lost most of its vegetation. Severe storms in 1896 and 1899 left behind a trail of dead sheep and cattle.

Beginning about 1900 Shackleford Banks residents began to migrate to other parts of Carteret County. Some moved to The Promised Land, a section of soundside property now in Morehead City. But most of them settled on Harkers Island, where the land was going for $1 an acre. They dismantled their homes and carried them across the sound on dories.

Charlie Hancock mending a net

Life went on much as it had in Diamond City. Most residents were fishermen and boat builders. They lived simply and what little money they had came from the shore whaling that they did during a short season each year.

According to amateur historian Mrs. Earl Davis of Harkers Island, whaling on Shackleford Banks had been a community effort. During the season the men of Diamond City would take turns watching for whales from Lookout Hill. Once a whale was sighted a crew of eight men would be put together to give it chase. The men shot old-fashioned harpoons and later, harpoon guns, from their sturdy little boats. The chase often lasted hours. Families who watched from the shore would later be enlisted in the laborious process of cutting the whale up.

After the chase

Once the dead whale was hauled ashore, blubber had to be cut off and dried out or cooked in large pots set up on the beach. The resulting oil was poured into 50 gallon barrels and sold to merchants in Beaufort and Morehead City. The bone, which was used mostly for corsets and umbrella ribs, also brought a good price.

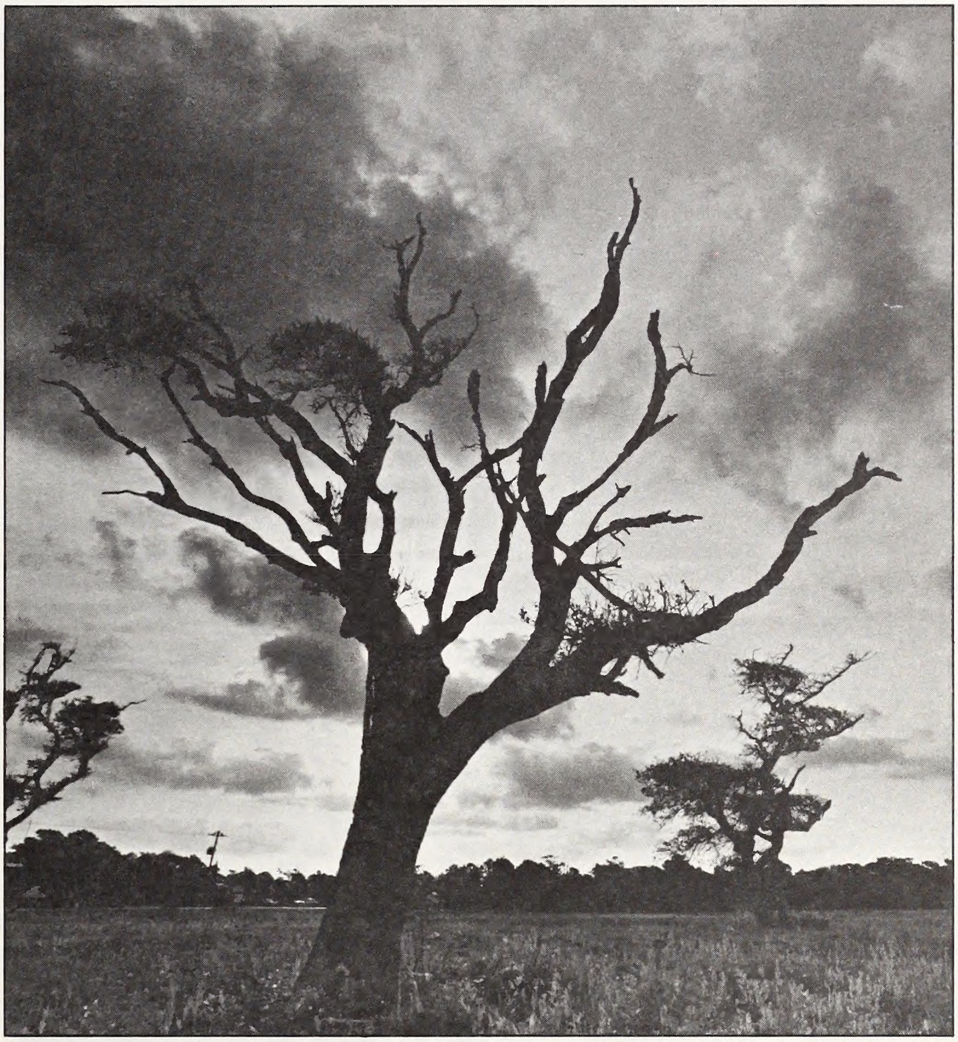
Diamond City whaling crews had a tradition of giving names to the whales they killed. Mayflower, caught one May 4, was reputed to be among the toughest to subdue. The Little Children was a whale killed by a crew made up largely of young boys.

Whaling days didn't end until 1918 and whaling stories are still told on Harkers Island. Charlie Hancock likes to recount one of the most famous of the Diamond City whaling stories.

"This is the story I've been told by my father who said he was told by his father," he begins.

It had been a long season without whales one year when Hancock's grandfather was a young man living in Diamond City. Finally one day a whale was sighted and the men went after it. They harpooned the whale but, after a long fight, lost it. "They hung to until after dark" but finally gave up the search and went home—disconsolate.

"It was a bright moonshiney night and my grandfather couldn't sleep. . . . In the night sometime he got to sleep but he dreamed that the whale had died and had caught up on the Cape Lookout point. He was a fast runner and he went around and told all the boys. 'The whale,' he says, 'I dreamed it so plain. It's there.' Some of them thought it was just a nightmare or what have you, but they decided to go look."



The remains of a maritime forest on Harkers Island

'One chance left'

As the story goes Hancock ran several miles to Lookout Point, by the light of the moon. Sure enough, there was the whale, beached.

"When the boys got there, he told them, 'Now we've got one chance left. We've got to go to Beaufort tomorrow and see if we can get rope enough.' And they had to do that by their honor because they didn't have any money."

Hancock sailed to Beaufort the next morning and found a merchant willing to let him have rope on credit. With the rope, the men secured the whale on shore. There was spending money that year after all.

I want Coastwatch

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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Ollie Moore in the O&D Grocery on Harkers Island

Of kerosene, fatback and snuff

Next time you get an earache, don't rush to the doctor for some newfangled antibiotic. Try an old fashioned remedy from Harkers Island. A little bit of the juice from cooked marsh mussels should do the trick. Or, if you're feeling adventurous, put a few drops of urine in the affected ear.

Those are two of about 50 home remedies that anthropologist Marcus Hepburn has collected as a sidelight to his research on Harkers Island. Hepburn believes that medical folklore can shed light on the traditional culture of a region.

A few of the remedies, he notes, make use of herbs. Ground mullen leaf, for instance, is frequently recommended for treating swelling from sprains. And sassafras tea is said to have the power to "break out the measles" in a person suffering from the fever which preceeds measles rash.

But Hepburn has found that most remedies remembered by islanders make use of more readily available items such as kerosene, fatback and snuff. A long soak in a tub of hot water and kerosene used to be the treatment for chigger bites.

"Most people remember hearing these remedies from their parents or grandparents," says Hepburn. "But few people still use them."

Charlie Russell is one exception. He still swears by his remedy for babies who are having trouble teething. Cut a piece of Jerusalem oak into tiny segments, he advises. Then string the pieces and tie the necklace around the baby's neck.

Hepburn believes that most of the folk remedies used on Harkers Island were popular in other sections of the state, too. But some seem to have originated on Harkers Island.

Take Ollie's salve, for instance. The recipe remains a secret because Ollie . . . died earlier this year without passing it on. Her daughter Ollie Moore remembers that the concoction required cooking and contained kerosene, lard, paragoric and a few other ingredients.

"She always called it her dream salve because the recipe came to her in a dream. I was small at the time and my daddy had a place that wouldn't heal on his foot." Mrs. Moore remembers that the salve cured her father's foot in a hurry.

That was only the beginning. Word of the healing powers of Ollie's salve spread. "People would come to her from all over when everything else failed . . . She'd always keep one of those tin coffee cans full and anybody who came, she'd give them some," says Mrs. Moore.

Sure enough, life has changed on Harkers Island. You don't know everybody you meet anymore. Not every family has a commercial fisherman in it. You can't walk out in the back woods "of a dewy morning" to shoot your dinner.

But Ollie Moore is good testimony to the fact that some things just don't change. Her roots on Harkers Island go back a long way. She was born there and her grandfather was born in Diamond City.

To sum it up, she says, "I was born and raised right on the waterfront. I moved across the highway. And that's as far as I want to go until I go behind the Methodist Church in Vergie Mae Cemetery."

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings and workshops, and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

Contaminated oysters can cleanse themselves of potentially harmful viruses if the oysters are transferred from polluted to clean water. That's the initial finding of the first in a series of relay experiments conducted by Sea Grant researcher Mark Sobsey of the University of North Carolina at Chapel Hill (UNC-CH).

In Sobsey's first test, oysters were experimentally contaminated with a harmless enteric virus that behaves like a pathogenic one. The oysters were then transferred, or "relayed," in special baskets to a research sanctuary in the North River outside of Morehead City. For a month, the oysters were sampled at intervals and checked for viral contamination. Sobsey found that, by the end of the four-week test period, less than 0.02 percent of the viruses remained. Sobsey expects the elimination rate to be even faster during warmer weather, when the oysters' metabolisms are more active. He will continue his relay experiments throughout the year to see how the cleansing rates vary with the seasons.

Twenty-three species of colonial waterbirds, including herons, egrets, ibises, gulls and terns, nest along the coast of North Carolina. But, as more of their natural nesting sites are upset, these birds are nesting on new, man-made sites.

These and other findings were the topics of discussion at a three-day planning workshop held May 17-19 in Wilmington. The workshop was organized by Sea Grant researchers Jim Parnell of the University of North Carolina at Wilmington and Bob Soots of Campbell College. It attracted representatives from the U.S. Fish and Wildlife Service, the Army Corps of Engineers, the National Park Service, the National Audubon Society, the North Carolina Wildlife Resources Commission and other agencies.

Workshop participants examined the status of waterbirds across the nation, and discussed ways to manage them. One management technique, building dredge-spoil nesting islands for the birds, received particular notice as an important management tool. Studies by Parnell and Soots in 1977 showed that nearly 80 percent of the colonial waterbirds in North Carolina nested on sites either built or modified by man.

Proceedings of the workshop will be published by UNC Sea Grant later this year.

Interested in improving your surf- and pier-fishing skills? If you're in the Nags Head area this summer, you can enroll in free classes, according to Sea Grant's recreation agent Dennis Regan. Pier-fishing classes will be held from 9 a.m. until 11 a.m. at the Nags Head Fishing Pier on Tuesdays and at Jennette's Fishing Pier on Wednesdays. Advanced registration is required for these classes. Participants should meet at the Marine Resources Center on Roanoke Island for transportation to the piers. Surf-fishing classes will be held at the Center from 2-4 p.m. Tuesdays and Wednesdays. Fishing equipment will be provided, but participants may bring their own gear. Classes will be offered from June 26 through August 29. For more information call Dennis Regan at 473-3937 in Manteo.

For the past four years, Sea Grant researchers have been experimenting with the culture of American eels for export to European and Oriental food markets. The eel farm now has new headquarters at the Pamlico Estuarine Laboratory on the shore of South Creek near Aurora. This year two new aquaculture projects have gotten started there and the site is on its way to becoming an aquaculture center for eastern North Carolina.

With mini-grant funds, eel farm researchers recently have begun a study to see whether coho salmon and rainbow trout can be succesfully raised in eastern North Carolina. Three hundred salmon and 150 trout now are being raised in cages in the canals which carry water pumped out of Texasgulf's open pit phosphate mine. The real test will come this summer when water temperatures are expected to rise close to the upper tolerance level of these fish.

Also at the Aurora site, fisheries biologists Howard Kerby and Mel Huish of North Carolina State University (NCSU) are conducting experiments to see whether striped bass hybrids can be successfully raised as a food crop.

In a related study, researchers at the UNC-CH Law School have reviewed North Carolina's laws affecting mariculture, the cultivation of marine organisms by exploiting their natural environment. Researchers Tom Schoenbaum and Cathy Martin, in findings presented to the N.C. Marine Science Council and the World Mariculture Society, have concluded that "In order to make mariculture a viable industry, North Carolina laws that adversely impact it will have to be revised to avoid limiting the industry's commercial potential."

Specifically, the researchers recommend that the Coastal Resources Commission be given authority to make

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regulations concerning the water above leased underwater sites; that nonresidents be allowed to lease land; and that increased evidence of productivity be required to maintain leases. They suggest that a more effective means should be found for handling already polluted areas than simply closing them off to cultivation.

In addition, the researchers recommend improved coordination among state agencies regarding fishing regulations and regarding the leasing of underwater mariculture sites. The leasing issue is one that is also being addressed by researchers at the North Carolina Central University Law School. The legal analysis of shellfish bottom leasing regulations around the country will lead to recommendations for state revisions of existing regulations. The researchers are Tom Earnhardt, Billy Ellerbe, Delores Faison, Gregg Spencer and James Finch.

The first of Sea Grant's graduate fellowships in marine sciences was recently awarded to William Peirson for a doctoral study that proposes to show how transplanted juvenile bivalves might be protected from their predators. The study will be conducted under the direction of Tom Wolcott of the Department of Marine Science and Engineering at NCSU. Results of the study will be particularly useful to the state's clam rehabilitation program because many of the juvenile clams transplanted each year are wiped out by blue crabs. By examining the behavior of these crabs, the researchers hope to develop a method for protecting the clams.

The fellowship program was initiated this year in an effort to expand Sea Grant's involvement with marine affairs within the university.

And to give marine affairs a boost in another area, Sea Grant has awarded funds to three students for advanced studies in marine education. The program is intended to develop educators with leadership skills in the field of marine sciences.

Recipients of the new fellowships are Beth Taylor, a teacher from West Carteret High School in Morehead City; Manley Midgett, a teacher with the Onslow County schools; and Bill Martin, a graduate student completing his masters degree in science education at East Carolina University.

The program, which is administered through the NCSU Department of Math and Science Education, also includes internships with state agencies responsible for marine education.

As a complement to a current Sea Grant study on the small-boat, recreational fishery of North Carolina, recreation specialist Leon Abbas of NCSU and sociologist Peter Fricke of East Carolina University have begun a study of coastal and ocean tournament fishing in the state. Through their study, the researchers hope to learn who participates in the tournaments, how they differ from unorganized recreational anglers, and how much money is generated by the tournaments.

Because the study will show the impact of tournament fishing on various species, it will have implications for fishery management. The information will also be useful to tournament organizers.

Hurricanes on the Coast of North Carolina is the title of a full-color poster recently produced by Sea Grant. The poster includes historical information on the major hurricanes of the 20th century, as well as details of how hurricanes form and what they destroy. For a free copy of the poster, write UNC Sea Grant, Box 5001, Raleigh, NC, 27650.

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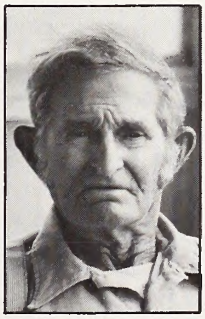
COASTWATCH

Companions under a canopy of low clouds at Cape Hatteras

Keeping an eye On the elements

Ronald Craddock's right hand sweeps out toward the southeastern horizon, drawing a wavy, imaginary line of mounded, cumulus clouds.

"When you see those clouds piling up to the southeast," he says, "you're in for some bad, stormy weather. My daddy used to call 'em the 'sand hills,' because that's what they looked like to him."



Craddock

In his seventy-six years in Mann's Harbor, spent mostly as a fisherman, Craddock has seen his share of storms. And years before the weather began posing for satellite photographs, Craddock was reading "the signs" and forecasting the weather.

"You can get the weather on the radio nowadays," Craddock says, "but those old timers, they'd look at the elements."

One sign in the night sky was uncanny: "If you see a circle around the moon, watch out," Craddock says. "And when there are stars inside the circle, you're looking for bad weather."

But the best sign-reading and forecasting of any generation can't offer warranties or rein in rough weather. In 1957, Craddock sat in a 32-foot shad boat and watched while a tornado danced toward him across the Albemarle Sound.

"We thought out time had come," Craddock recalls. "We saw it a-comin' out in the Alligator River, right white. We didn't have much time to get

Continued on next page

ready. We took some beating up there in the widest part, but it didn't hit us straight on. It ricocheted around us. About the only thing you could do was stand there and hope."

Like most other professional fishermen, Craddock has lost small fortunes in equipment to "the elements." Hurricane Hazel shanghaied all of his pound nets and "cleaned me out," Craddock remembers.

Twice, when hurricanes flooded his village, water climbed the steps of his house to its porch boards. Both times, he moved his house to higher ground.

Inching along

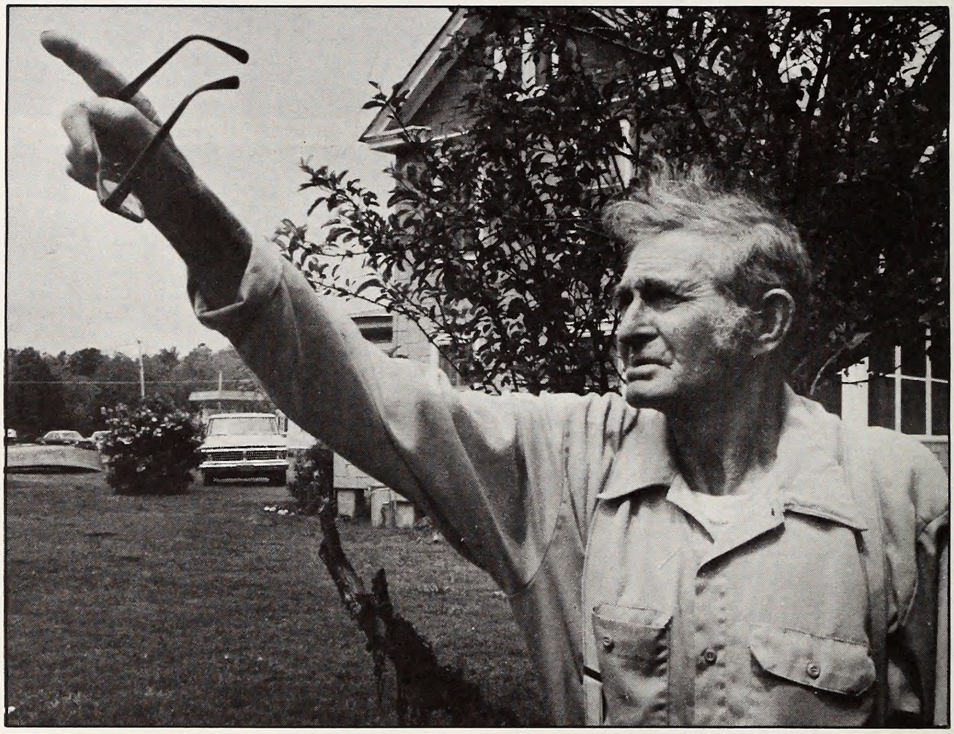
Craddock's son, Wildon, who has often helped with his father's fishing business, describes what foul weather means to someone whose livelihood depends on the elements.

"Many days, Dad and I would go out, and we'd just have to inch our way along, knowin' that it wasn't fittin' to be out, but hopin' we could get maybe one hour's work between sunrise and sunset, because the fish are going to rot if you don't get to 'em. There's a dedication to get back to those nets."

For families like the Craddocks, up and down the coast, this battle with nature is a way of life. And, because the economic life of the region depends so heavily on fishing, tourism and recreation for sustenance, foul weather touches the quick of the coastal economy.

An early spring or late fall lengthens the tourist season and enriches the economy. But late springs, or cold weather too early in the fall, strap almost everyone who has a business interest in the coast. The losses for realtors, charter-boat operators, fishermen and restaurant owners translate into losses for the merchant and laborer as well.

With their lives so entwined with the elements, coastal residents like Ronald Craddock betray an almost inexpressable awe when the conversation turns to weather. What, they wonder aloud, makes weather work the way it does? Says Craddock: "Sometimes you think there's something behind it. When you see those dark clouds, you wonder. . ."



Ronald Craddock: drawing "sand hills" on the horizon

Finding the forecast

If a summary weather forecast is all you need to plan your day at the coast, reports form local radio and TV stations may suffice. If you'd like more detailed information or personal service, here are the numbers to note:

762-3240

—The marine forecast telephone line of the National Weather Service's office in Wilmington. A recorded message describes weather systems, relates meteorological information, and gives a five-day "recreational outlook" covering the coastal area between Cape Hatteras and Little River Inlet, including the Gulf Stream and waters 100 miles off shore. You can get personal assistance weekdays (except holidays) between 7 a.m. and 9 p.m. if you stay on the line after the recording has played. Your call will "ring through" to office personnel.

995-5610

—The weather-line to the National Weather Service's office at Cape Hatteras. A recorded message gives current meteorological information and a five-day forecast for the Outer Banks and coastal area between Kitty Hawk and Cape Lookout. The office has personnel on duty to answer ring-throughs for assistance each weekday (except holidays) between 9 a.m. and 5 p.m.

162.55, 162.40, 162.475 MHz

—The radio bands for weather information from the National Oceanic and Atmospheric Administration (NOAA). Weather forecasts and meteorological information are revised every six hours; storm bulletins and weather advisories are renewed every two hours. To pick up the weather bands requires a special receiver. But small, inexpensive radios that can home in on the signals are commonly available in radio shops along the coast.

Here is a list of broadcast areas and their corresponding weather bands:

Asheville	162.40	Myrtle Beach	162.40
Bristol	162.55	New Bern	162.40
Cape Hatteras	162.55	Norfolk	162.55
Charlotte	162.475	Richmond	162.475
Durham	162.55	Tarboro	162.475
Fayetteville	162.475	Wilmington	162.55
Florence	162.55	Winston-Salem	162.40

Surf, sails and seasons: everything rides on the wind

What can you get from a forecast, besides the odds for rain and an educated guess at the highs and lows? Note the wind speeds and directions, as well as tides and water temperatures. Think what sort of conditions would be nice for the activities you're planning. But if the forecast is for sunny and warm, is that all you need to know? Not necessarily.

Let's say you want to try out your new surfboard in something a little more rambunctious than pond water. If Saturday's coastal forecast calls for sunshine and winds out of the south or southwest, as it often does in summer, then the surf along most of the state's beaches is likely to be flat as yesterday's cola. Your best bet might be the water off Bogue Banks, Shackleford Banks or Cape Hatteras, whose beaches more nearly face the wind, and therefore a rougher surf.

Look at the map and apply a simple principle: wind pushes water. If, on its way to the beach, the surf gets a shove from behind, presto! breakers. But, if the breeze meets the surf head-on, then the water will hunker down and be peaceable for swimmers, sailors and surfcasters.

Beach weather

Beginning in May, Summer sidles up the North Carolina coast, and stays there through September. Temperatures camp in the eighties during the day and drowse in the mid-60s to low-70s at night. Water temperatures remain above 70 degrees into October, and, as late as November, there are days when the water and air are warm enough for swimmers.

Fishing

For about ten months of the year in coastal North Carolina, the elements smile on the fisherman. June through September are the months of shirtsleeves and light jackets. Fishing in fall and spring can be equally pleasant, but carry heavy clothing, a water repellent and wind-resistant jacket for the occasional cold and wet weather.

Boating and sailing

If you've ever shoved off with only a boat between you and the elements, then you probably know to keep at least one eye on the weather.

Peter Fricke, a licensed mariner, advises pleasure-craft operators to get accurate weather information before they launch, and to use a marine VHF radio to monitor Coast Guard stations for bulletins while boating.

"Always listen to the forecast," Fricke says, "and never go out in anything more than a moderate breeze."

Fortunately, many days of the year are fine for boating in the state's coastal waters. Breezes of seven to 16 knots, ideal for sailing, are common with the prevailing winds, which are southerly or southwesterly in spring and summer, but northerly and northwesterly by September. The sea breeze, a regular fixture in summer, makes local adjustments in the prevailing air flow. Autumn usually brings stronger gusts, but many fall days are beautiful for boating.

The weather man assures you that the wind is in your corner. What other

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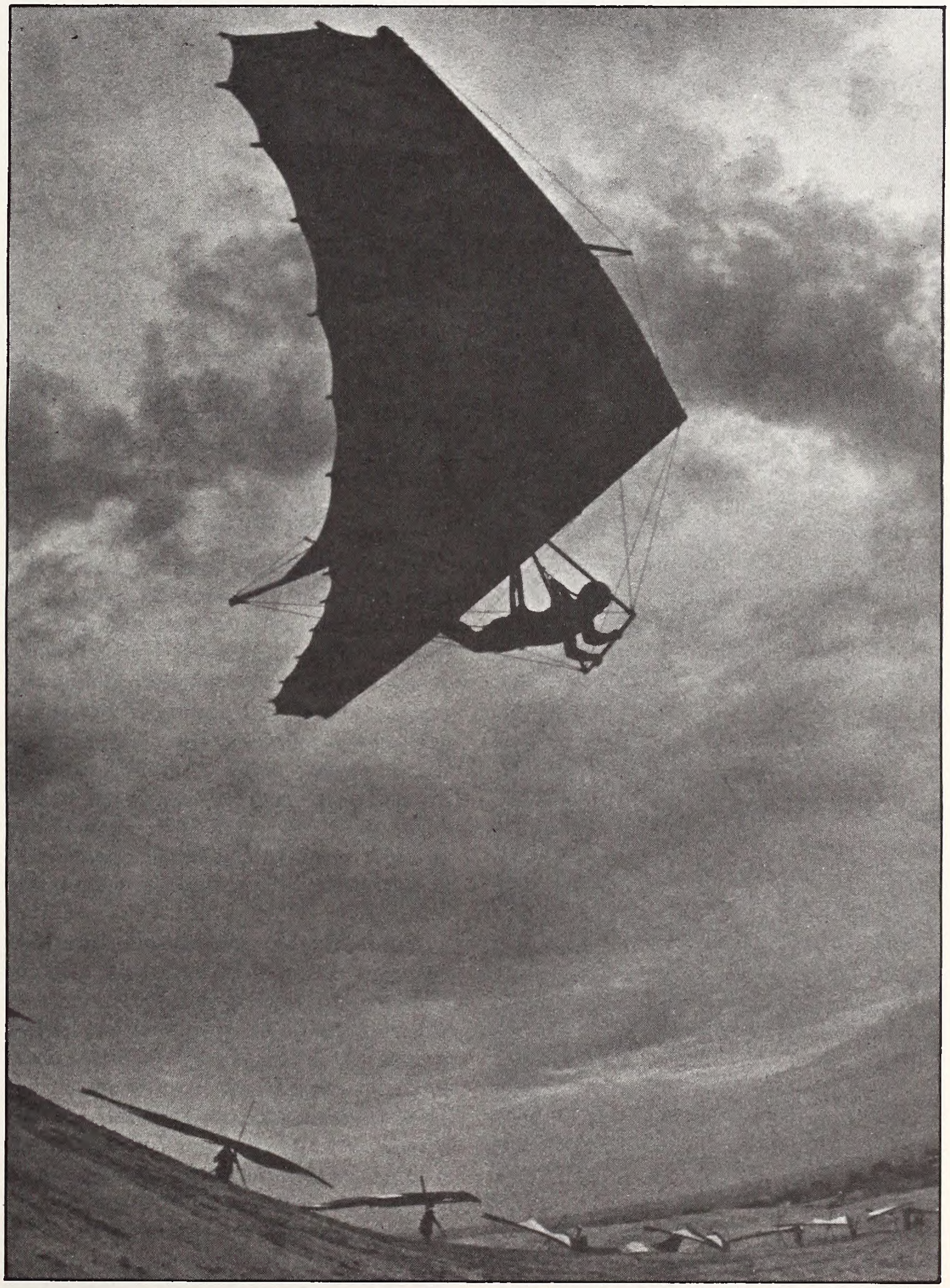


Smooth-sailing at Jockey's Ridge

cooperation do you need from nature? Good visibility and merciful water.

During fall and winter, fog and rain limit visibilities to less than two miles ten per cent of the time, and to less than one-half mile four per cent of the time. But September through August, morning fog limits visibilities to under two miles only two to eight per cent of the time, and to less than one-half mile about three per cent of the time. Afternoons are usually clear.

Fricke stresses that navigation without radar is risky business when visibilities are low, because rain and fog can obscure landmarks. Unless your boat is fitted with a radar reflector to warn traffic of your position, Fricke says that you should "pull over and anchor" if a fog catches you in the sounds or inlets.

Waves

Waves are normally amicable to boaters and sailors spring through fall. Gauges along the beaches from Currituck to Sunset Beach measure summertime waves of three feet or less as much as 80 per cent of the time.

In open seas, waves are three feet or less about 35 per cent of the time in waters north of Cape Hatteras, and about 45 per cent of the time in waters to the south. Seas are usually much more choppy in fall than in summer.

Inland waters also tend to have waves of three feet or less in summer, although the sounds, because of their shallowness, sometimes become especially choppy under a stiff wind.

"In the sounds, a wind blowing for a long period of time will tend to lower the level of the water at one end of the sound, and raise it at another," Fricke explains. "If you're at the up-wind part, you can go aground." These "wind-tides" can be as much as two feet in the sounds, he says.

Hang gliding

The same winds that built Jockey's Ridge into the East Coast's largest live sand dune lift hang gliders aloft almost all year.

Hang gliding is best when winds striking a face of the ridge are forced into a vertical flow, providing lift for the kite. The ridge's orientation makes any but a northerly or northwesterly wind navigable.

John Harris, a veteran flier and part-owner of Kitty Hawk Kites, says that "one of the best things about the weather here is that the coastal winds are generally smooth."

The waters surrounding Hatteras temper the winds and make flying less work than in the mountains, Harris says. He recommends that beginners fly when winds are flowing between five and 15 mph. Experienced pilots can safely negotiate winds of up to 30 mph. Wind-speed data taken at Cape Hatteras indicate that conditions are good for flying at least 50 per cent of the time from March through September. Early afternoon is usually the best time to fly, but gliders can often find good breezes in the morning and evening as well.

Harris adds that, although winter days are often too blustery or wet for flying, almost every week of the year has at least one day suitable for hang-gliding.

How the weather works

Maybe you're on vacation, and your hot-line to the real world is temporarily off the hook. You'd rather not punctuate your day with news and weather broadcasts. Or, maybe you're just curious: Can a do-it-yourselfer keep up with the weather?

According to Albert Hinn, meteorologist in charge at the National Weather Service's office in Wilmington, "You can tune out the world and still tune in to the weather."

Hinn says that tuning in requires alertness and a little basic knowledge. To orient the novice to a study of coastal weather, Hinn describes the "typical summer day on the North Carolina coast."

Bermuda high

This typical day gets its sweet disposition from the Bermuda High, an area of high pressure centered approximately over Bermuda. The influence of this high creeps northward up the coast, during the summer. In spring and early summer, the high brings warm, slightly hazy air and breezes out of the southwest. By late summer and early fall, the high has moved far enough north to bathe the coast in an easterly flow of sparkling air from the Atlantic.

Occassionally, this fair-weather pattern is over-powered by major weather systems, usually moving in from the west. If the day begins with clouds, or is heavily overcast by mid-morning, you can expect that such a system is passing through, possibly with a load of rain.

So the typical beach day, thanks to the Bermuda High, dawns sunny, with a slight breeze— the sort of morning sailors and beachcombers cherish. What happens next depends largely on local conditions and a phenomenon known as the sea breeze. As the sun heats the land mass back of the beach, air over the land also warms. The air rises as it's heated, leaving a ground-floor vacancy that cooler air from off shore rushes in to fill. This rush is called the sea breeze. Through the day, as the heating becomes more intense, the exchange of air is more rapid and the sea breeze is stronger. Toward noon, the water is choppy and a few billowy clouds ride landward on the breeze.

Sweeping the state's southern beaches, the sea breeze helps keep ocean-side temperatures in the 80s, even though the mercury may be shooting into the 90s just a few miles inland.

On days when the heating and convection of air are especially intense, this sea breeze can build into a stiff wind by mid-afternoon.

But the Outer Banks are a notable exception to this pattern. As Hinn explains it, "On the Outer Banks you don't get much of a sea breeze because you're surrounded by water. It's awfully hard for air to really heat up and get that kind of reaction."

Water - cooled

The Outer Banks get their air conditioning in another way. The waters that surround the islands temper the heat and keep the average daytime highs in the mid-80s most of the summer.

"With our sounds and the ocean, it doesn't get as hot here," says Lucy Stowe, the principal assistant at the National Weather Service's office in Cape Hatteras. Because of the marine environment, she says, spring on the islands is brief, winters are warmer than on the mainland, and storms are less intense.

"The water keeps a damper on things," she says.

Typical day, afternoon: The convection of warm, moist air is piling up mounds of cumulus clouds along a scrimmage line somewhere inland, where the prevailing wind and sea breeze are butting heads. The plot thickens. Thunder becomes a background theme in the music of the beach.

Thunderstorms

If you're still tuned in, the next character you're likely to expect on the scene is a thunderstorm.

Thunderstorms erupt in the coastal areas of North Carolina 40 to 50 times a year. Wilmington averages seven days of thunderstorms in June, eleven in July and nine in August.

"A fair statement about the North Carolina coast," Hinn says, "is that there's usually a chance of afternoon showers and thunderstorms."

Thunderstorms brew in two ways. The first and most common type begins as a concoction of moist air, heated by the land, that rises into the lower levels of the atmosphere, where it condenses and forms clouds. If there are winds aloft, say at 35,000 to 50,000 feet, they vent the system, as a breeze does a chimney, and allow the clouds to pile up, sometimes as high as ten miles.

The second general type of thunderstorm forms when an invasion of cool, heavy air pushes under warm, moist air. The warmer air, being lighter, can rise and ride the cool air piggyback. Result: condensation and clouds. This interaction can bring a line of thunderstorms across the beaches at any time of day.

In either case, the churn of wind, warmth and moisture is likely to spew rain and crackle with lightning.

"Winds and seas also come up with the thunderstorms," Hinn points out, "because you're getting the updraft, which is causing those clouds to build to such tremendous heights, but you're also getting the downdraft, which most people have experienced as that first gust before the storm."

As the sea breeze runs out of gas late in the day, these thunderstorms or showers can move off and miss the beaches altogether, or they can march toward the sea on the prevailing winds.

If the showers do come, how long will they last? Hinn says that because the average summer storm has a diameter of about ten miles and travels about 20 mph, it usually causes about one-half hour of disruption.

Once past the beach and over cooler water, the storms usually mellow until they reach the warm Gulf Stream, 20 to 60 miles off shore. "It's like taking a pot of hot water, and it's bubbling over the land, until it gets out over the water and calms down some. Then it gets out over the Gulf Stream and starts bubbling again." Hinn calls these off-shore thunderstorms "our own coastal fireworks display."

But a few times each year, things fly off the handle. If a high-powered weather system moving east across the state lands in the lap of a local storm, the result is often a super-charged thunderstorm with high winds, driving rain and, occassionally, tornadoes.

The great acceleration of wind in these super-storms can uproot tents and raise waves stout enough to swamp boats and flood low-lying acreage.

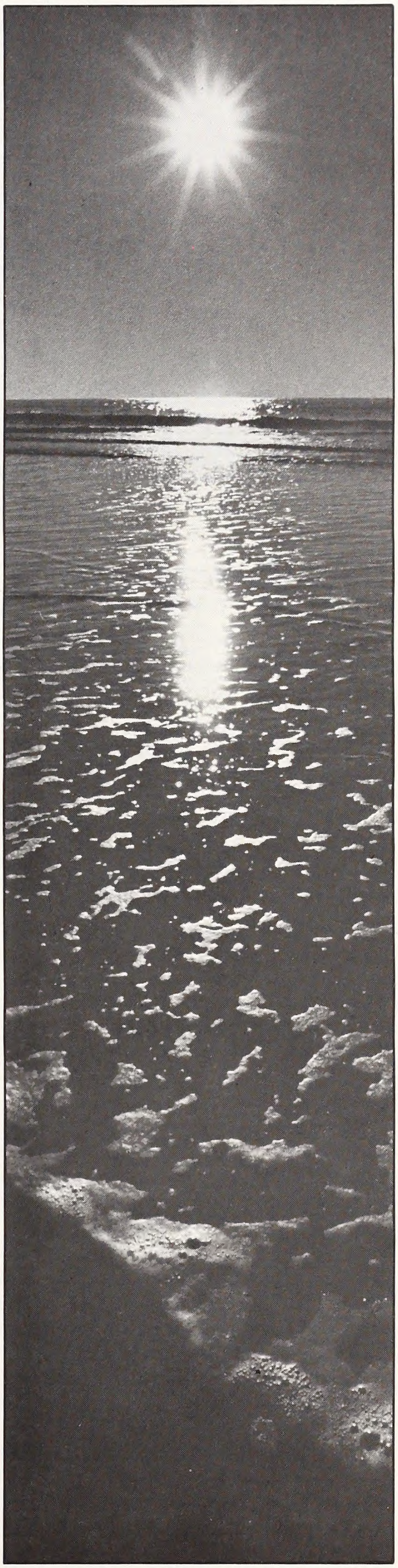
By the time things get that out of hand, the amateur meteorologist should be exactly where the pros are—under shelter.

Fall and winter

A gradual shift in the flow of air brings winds out of the north in late fall and winter, and signals cold weather. The ocean surrenders its heat slowly, so the waters along the coast stay warm, often in the 70s and low 80s, until October or November. The tempering effect of the water postpones very wintry weather until the months from December through February, when winds are often rough and waves commonly reach ten feet. Rain and fog are also more likely than in summer.

Interrupting this pattern of north winds, rain and fog is an occasional "northeaster," the infamous storm system most common in the winter months.

Northeasters are low pressure systems migrating east, or north along the coast. Since these low-pressure systems are counterclockwise motions, the force of their winds often slams into the coast with a hooking motion from the northeast. Sometimes these winds reach hurricane force and the waves they generate can maul real estate and rearrange the landscape. Powerful northeasters are often more destructive than tropical storms, since the northeasters are very large and can blow relentlessly for days.



The "typical" summer morning: sunny-side up at sunrise

The white-capped beach nester—common to the state's coast, has plumage to protect his skin from sun

Weather-proofing your beach trip— for safety's sake

If nature answered to a truth-in-packaging law, there might always be a disclaimer like this stamped across the sky:

"Caution: The weatherman has determined that today could be hazardous to your health."

To stay one jump ahead of mishap at the coast, do a little planning and keep an eye on the elements. These are the basic trouble-makers to look out for:

Sunburn

A few hours of carelessness, or too much hurry for a golden tan, can spoil a vacation. Take a tip from the people who live at the coast: wear clothing, including a hat.

Says Dr. James A. Finger, the Health Director in New Hanover County, "The way to prevent sunburn is to minimize your exposure to the sun, and wear protective clothing."

Mild sunburn, Finger says, can be soothed with commercial lotions and ointments. Severe burns and those with blistering are medical problems and require treatment by a doctor.

Finger suggests that a person's first sunbathing sessions of the season be limited to 15 minutes, with gradual increases over the summer, as the skin becomes more pigmented. The well-tanned sunbather can take up to two hours of sun, he says. Screening lotions can extend the safe exposure times, but only by about a third.

Remember, clouds don't shield you completely from radiation, and it's very easy to toast yourself on a cloudy day.

Heat stroke

If you're planning some rigorous activity outdoors at the coast, take a few precautions against heat exhaustion and heat stroke.

Overheating, combined with the loss of chloride and bodily fluids, can dangerously raise the body's temperature, drop the blood pressure and cause shock. The victim of heat exhaustion or stroke should be moved into cool shade to wait for a doctor.

To prevent overheating, protect your head from the sun, drink water and exercise in moderation. Salt tablets can reduce the risk of heat exhaustion, if they are dissolved before ingestion, Finger says.

Lightning

Lightning kills more Americans each year than any other weather hazzard.

If you're outside—on a golf course, a beach or in a boat—when a thunderstorm approaches, find shelter. The safest places are indoors or in a car, where tires provide some insulation from electricity. Avoid trees or anything tall that will attract lightning. If you're boating and can't reach shore, go into the cabin. The safest place in an open boat is the floor.

How do you know when to take cover? Albert Hinn suggests that you keep track of the lightning and notice if it's coming closer.

"Time the number of seconds it takes from when you first see lightning to when you first hear thunder," Hinn says. "If it takes about five seconds to hear the thunder, you've got roughly a mile of distance from you to where that lightning is occuring."

If a companion is struck, don't assume the worst. Use first aid for shock and call a doctor. Even if the person seems dead, begin first aid and call an ambulance. Check for a pulse and watch the chest for breathing. If you are trained in cardioplumonary resuscitation, and it seems necessary, use it.

"More people survive than are killed by lightning strikes," Hinn says.

Severe storms

Thanks to modern instruments, large tropical and extra-tropical storms are usually forecast days in advance.

In recent years, North Carolina has escaped the kind of wholesale destruction caused by hurricanes in the 1950s, although some weather-watchers say that the state's luck is about to run out.

If a hurricane or tropical-storm watch is issued for the coast, don't plan to travel there until it's been lifted. If you live in the coastal area, make sure your belongings are secured and protected, and find shelter in a solid building situated on high ground.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out more about meetings and workshops, and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

They say you can't judge a book by its cover, but three Sea Grant researchers say that packaging can affect sales of seafood. That's why the researchers are studying not only how to keep fish fresher in the store, but also how to make it more appealing.

Tyre Lanier, Frank Thomas and Ed Leonard are asking shoppers about three types of packaging systems. One is the standard overwrapped foam tray found at most grocery stores. But the other two systems are new. One is a vacuum package that allows fish processors to control the amount of air that surrounds the fish in the package. The other is a new tray made of plastic like that used in freezer containers.

Researchers are asking shoppers which package they would buy, which package they find most attractive and which package they feel keeps the fish fresh.

While the researchers are concerned about shoppers' preferences, they are also running laboratory tests at N.C. State University to see whether vacuum packaging or the currently used plastic wrap keeps fish fresher.

Lundie Mauldin, Sea Grant's education specialist, has spent most of her summer introducing groups of teachers to the North Carolina coast.

In a series of workshops held in June and July at the three N.C. Marine Resources Centers, Mauldin's groups examined the coastal environment as both a subject and setting for study.

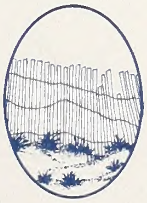
Field trips took teachers to boatbuilders, wildlife habitats, maritime museums, fishing villages and research sites. At an excavation by Dr. David Phelps, an archeologist with East Carolina University, one group of teachers watched as the 1000-year-old fossil remains of three Indians were being uncovered.

An innovation of this year's workshops was a discussion of maritime literature led by Norma Bagnall of the Sea Grant program at Texas A & M.

Wayne Wescott, who is working on a Sea Grant project through the department of continuing education at East Carolina University, has been organizing a number of courses along the coast. A course designed to prepare navigators for the Coast Guard's captain's licensure exam has drawn about 30 people to each class since the course began on June 6.

Demand for the course has been so great that Wescott hopes to have courses in Southport, Hatteras and Manteo, later this year.

In addition, Wescott is putting together a course for shrimp fishermen that he plans to conduct at several locations along the coast.



Harkers Islanders celebrated the Fourth of July this year with their annual "pony penning" to round up the wild horses that roam Shackleford Banks. Islanders have been holding the pennings for over a hundred years to brand the new foals. Though the horses are owned, they are allowed to wander the banks freely.

Harkers Island boys run on foot to corral the horses into pens where mares with new foals are separated from the rest of the herd. The foals are then given the same brand as their mothers.

Amost 130 horses were penned this year, but one stallion and his mares at the east end of the banks eluded the roundup. The stallion, called the Big Marsh Stallion, has never been corralled.

Marcus Hepburn, an anthropologist living on the island, observed the penning this year as part of a Sea Grant study on life in a fishing community.

As a leader in three state agencies J. C. Jones spends lots of time behind a desk. But whenever he gets the chance, he hoists sail and skims the coastal waters of North Carolina in a sailboat.

"The coast is one of my favorite hangouts," he says. In his newest job as Sea Grant's director of Marine Advisory Services, he will develop even stronger ties to the coast.

In addition to his duties at Sea Grant, Jones will remain as director of the state Office of Marine Affairs and administrator with N.C. Agriculture Extension Service. He plans to coordinate the marine activities of the three agencies.

Jones is a native of Chatham County. He received his undergraduate degree at North Carolina State University and his master's degree at Duke University. A retired Navy captain, Jones trained the Navy's underwater demolition team for eight years.

Jones has spent 24 years in the extension service, eight as chairman of the 15-county northeastern extension district.

Dennis Regan, Sea Grant's recreation agent, has scheduled a series of lectures on Thursday nights at 8 p.m. at the N.C. Marine Resources Center on Roanoke Island. The schedule is:

Aug. 9—David Phelps on coastal plain Indian culture;

Continued on next page

Aug. 16—Paul Hosier on the effect of off-road vehicles on the beach environment;
Aug. 23—Marie Louise Peterson on wildflowers of the Outer Banks;
Aug. 30—Glen Eure on folklore of the Outer Banks.

Remember the self-cleaning oyster? Well, he tidies up even faster in warm weather.

The Back Page reported earlier that Mark Sobsey, a Sea Grant researcher, was relaying oysters from polluted waters to clean waters in the North River near Morehead City. In winter months his tests showed that contaminated oysters eliminated 99.9 percent of the viral contaminants in their systems by the end of a four-week period.

In experiments conducted in March and April when water temperatures were between 59°F and 68°F in the North River, Sobsey found that oysters flushed 99.9 percent of the contaminants from their bodies in three days.

Those are our shrimp! They grew up in our rivers," say Louisianians. "But they're in my waters now," say Texans. Whose shrimp are they and who controls the fishing rights to them? Those are the sort of questions state and federal representatives from across the country will discuss in Raleigh, Oct. 29 through 31, at a conference on state and interstate fishery jurisdiction and management.

The conference is a cooperative effort of the UNC Sea Grant College Program, the national Sea Grant office in Washington, D.C., the Coastal Plains Center for Marine Development Services, the N.C. Marine Science Council, the N.C. Department of Administration's Office of Marine Affairs and the N.C. Department of Natural Resources and Community Development. North Carolina Gov. James B. Hunt Jr. is supporting the conference.

For further information, write John T. Pittman, Office of Marine Affairs, 116 W. Jones Street, Raleigh, N.C. 27611.

It took some untangling, but the students in Jim Bahen's surf fishing classes for children eventually got their lines wet.

Bahen, a Sea Grant advisory agent in the Wilmington area, customarily works with a more seasoned clientele.

But, on July 3, he met 20 students, ages 5 to 11, at the N.C. Marine Resources Center at Ft. Fisher, and taught them the whys and wherefores of fish, tackle and safety. Then he took them to the surf for some first-hand experience.

Several snarled lines and misplaced casts later, the youngsters were pulling in some respectable spot.

Bahen also helped with a coastal crafts day, held June 14 at the Center.

Assessing Man's Impact on Wetlands is a technical examination of wetlands and the evaluation of man's impact upon them. In this report, author G. E. Galloway of UNC-CH proposes a comprehensive Wetland Evaluation System and discusses the application of this model. For a copy, write UNC Sea Grant and ask for UNC-SG-78-17. Single copies are free to North Carolina residents; out-of-state charges are $4.

Atlas of Colonial Waterbirds of North Carolina Estuaries is a study of birds like the egret, heron and tern, which live along the state's estuaries. The atlas, compiled by James F. Parnell of UNC-Wilmington and Robert F. Soots Jr. of Campbell College, includes numerous photographs of the birds and charts of their nesting grounds. For a copy, write UNC Sea Grant and ask for UNC-SG-78-10. The cost is $7 for all requests.

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COASTWATCH

Photo by Ron Thrower

A diver climbs toward the surface and the boat's ladder

A glimpse of life At 60 feet under

As thunder rumbles near Beaufort Inlet on a muggy July morning, a dive boat sputters to a halt and drops anchor.

Bob Eastep shrugs his air tanks onto his shoulders, tightens his face mask over his eyes and nose, bites his mouthpiece, perches himself on the side of the boat and rolls sideways into the grayish sea.

Eastep's head quickly bobs to the surface where he watches his dive buddy, Terry Leonard, slip into the water beside him. The two men signal "all's well" to the boat captain, upend themselves in the ocean swells and disappear.

10 feet below . . . The feeling of weightlessness overtakes them. The 60-pound tanks are no longer a burden and the divers revel in their own effortless motion. The slightest flip of a finned foot propels them downward.

20 feet below . . . The divers' eyes adjust to the growing dimness. The sea is like a shadowy room at dusk where color and contrast between objects is dulled. The sea is bathed in shades of blue and green, often concealing the brilliant colors of its inhabitants.

30 feet below . . . A school of fish glides gracefully by the divers. Their steady, unhurried movement hints of a slower pace in this undersea world. The wreckage of an old British trawler looms in the murky distance.

50 feet below . . . The divers explore the encrusted remains. They find the sea has claimed this man-made vessel as its own and converted it to feeding grounds and living quarters for the

Continued on next page

Schools of fish glide through their undersea world

Photo by Ron Thrower

creatures of the sea. Amberjack, angel and butterfly fish now meander the decks and hide in the crevices.

North Carolina diving

More and more Americans are taking to the seas to dive and North Carolina waters are particularly good seas to take to.

For divers seeking a history lesson, the North Carolina coastline is littered with thousands of wrecks ranging from Civil War blockade runners to German U-boats.

For divers interested in observing the creatures of the deep, snapping their pictures or maybe spearing a few for dinner, the wrecks offer another advantage. They act as artificial reefs and attract a variety of marine life.

"I dive because you can see more life in the ocean in one hour than you can see in your whole life on land," says Jay Greenblatt, former president of the University of North Carolina at Chapel Hill Dive Club.

The warm Gulf Stream curves north along the North Carolina coast, while the Labrador arctic currents move southward. The two meet near Cape Hatteras and go out to sea, but their meeting serves as a mixing ground for tropical and cold-water fish.

"It's amazing," says Shirley Kelley, a diver from Raleigh. "You can see a barracuda and a codfish swimming side by side on a wreck in these waters. There are very few places in the world you would find that sort of thing occurring."

Wrecks are not the only places sea life congregates in North Carolina waters. The coast also has a few natural reefs where divers can see marine creatures in a natural setting.

While some divers are attracted by the wrecks and the fish, many people initially dive to experience the weightless feeling that comes with being underwater, says Paul Goetz, a dive instructor and president of the North Carolina Wreck Diving Club. Eventually though, he says, the divers turn to other underwater hobbies like photography, selecting fish for an aquarium, or collecting shells.

Whatever the reason for diving, more people are investing the time and money it takes to do it, say North Carolina dive shop owners and instructors. Divers are now having to arrange their dive parties and charter their boats two and three months in advance. Bob Eastep, owner of Discovery Dive Shop in Beaufort and a diveboat captain, said he is already booking diveboat charters for next summer.

Even though the charter may be booked months in advance there is still a chance the divers may never leave the dock because of weather conditions. Eastep says he doesn't like to take divers out in stormy conditions or seas over three to four feet because of the difficulty getting them in and out of the boat in the ocean.

Also, if waters are rough, underwater visibility is likely to be low because sand and silt are being stirred up.

Certification

But there are few other limitations to diving. Instructors emphasize that anyone who is an adequate swimmer and in good physical shape can become a diver after a thorough diving certification course.

Diving certification is not required by state or federal law, but divers, dive shop owners and boat captains regulate the sport themselves.

"Almost all diving operations ask for a certification card or evidence that a person has been trained in diving before they are going to let him go on a dive trip, rent equipment or sell him breathing air," says Ron Thrower, instructor and owner of the Sea Wolf Dive Shop in Raleigh. "It's sort of a common law. We have a certain responsibility to the public and to ourselves to see that the sport stays safe."

Instructors stress that certification courses are needed to familiarize people with the equipment and the do's and don'ts of diving.

"Much of what goes on in diving courses is teaching students how to deal with unexpected situations like having your mask flood while underwater," says Goetz.

Another objective of the diving course is to dispel fears people have about marine life such as sharks and eels. Seasoned divers scoff at movies like "Jaws" and "The Deep," saying the writers and producers are misleading the public about these normally harmless creatures.

"In the water, to a shark, you are just another big fish, and, as long as you don't start thrashing around and drawing attention to yourself, they will swim right on by," Goetz says.

Shirley Kelley offers this rule when diving. "If you don't know what it is, don't touch it, and keep your hands out of cracks and crevices," she says.

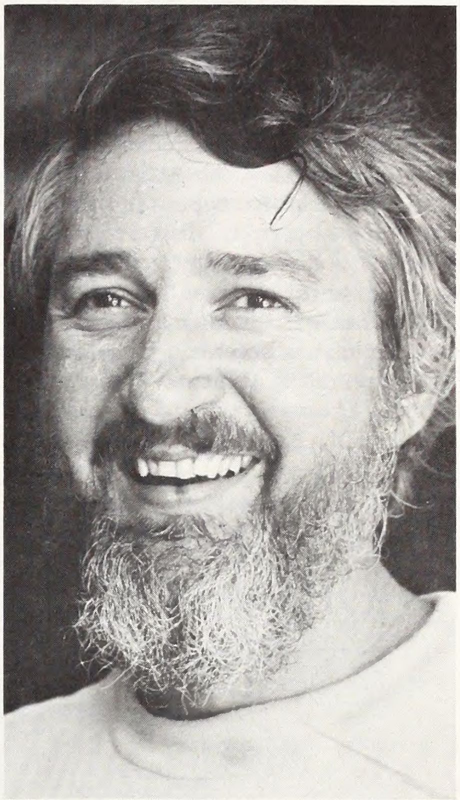
"It's an incredible world down there and a friendly one too," she says. "What makes me so sad is that everybody is afraid of it. It's like being afraid of a flower garden."

Topside again

Eastep glances at his watch and sees that he and Leonard have only a few minutes of bottom time left—time needed to locate the anchor line before ascending. 40 feet . . . 30 feet . . . 20 feet . . . 10 feet . . .

Beside the boat, Eastep's head and shoulders emerge from the swells. "Good dive" he shouts to the captain. He swims to the ladder attached at the boat's stern and ducks his head under the water to remove his flippers. As he hands his flippers to the captain, Leonard's head pops out of the water behind him. Eastep looks back at him and grins before climbing the ladder. Leonard soon follows. Both begin to remove their wet equipment that now gleams in the morning sunlight. They talk rapidly about the things they've seen.

Photo by Neil Caudle



Ron Thrower

Some diving essentials

Diving is an expensive sport, especially if divers frequent the coast with any regularity. Certification courses cost anywhere from $50 to $100. A full set of new equipment will range in price from $400 to $800, but you can rent it by the weekend for $20 to $30. A short trip on a chartered dive boat (one dive) will probably run between $20-25 and a longer trip (two dives) will cost $40-50.

Diving rules

—Take a certification course with a good dive instructor. The YMCA, the National Association of Skin Diving Schools (NASDS), the National Association of Underwater Instructors (NAUI), the Professional Association of Diving Instructors (PADI) and SCUBA Schools International offer good diving courses.

—Be familiar with the prospective dive site and plan your dive. Be sure the conditions at the site are within your diving capabilities.

—Make sure your boat captain puts out a divers' flag.

—Never dive alone. Dive with someone whose abilities you can trust in an emergency and maintain contact with your buddy throughout the dive.

—Ascend according to the Navy dive tables or the NOAA dive tables.

—Watch for any symptoms of decompression sickness—rash, dizziness, pains or nausea. Even a minor case of the bends, left untreated, can intensify and become crippling.

—Never dive if you have a cold. Diving with a head cold can result in a ruptured eardrum, while diving with a chest cold can lead to embolism, or blockage of blood vessels by air bubbles.

—Never consume alcohol or other drugs before diving. Drugs affect the body differently underwater where pressure is increased. A diver's judgment may be dulled and he may be more prone to decompression sickness and other physical problems.

—Divers should refrain from smoking at least one hour before diving. Smoking impairs breathing and decreases the body's ability to supply oxygen to vital tissues. For smokers, a conservative approach to the Navy's dive tables is recommended.

—Sport divers should not dive at depths greater than 110 feet. Below that depth, divers are susceptible to nitrogen narcosis, more commonly called "rapture of the deep," which affects the diver much the same way as alcohol.

Equipment

Since man doesn't have gills and fins like fish to help him underwater, he needs special equipment to adapt to the ocean environment. Here's a list of equipment instructors suggest divers have: mask, fins, buoyancy compensator (controls buoyancy underwater and acts as a lifejacket on the surface), weight belt, air tanks, wet suit, regulator, pressure gauge, waterproof watch and an underwater knife.

Divers flock to state's graveyard of sunken ships

The remains of thousands of vessels lie strewed across the ocean floor off the North Carolina coast. Nicknamed "The Graveyard of the Atlantic," the state's treacherous capes and sandy shoals have proven disastrous for many a worthy sea captain during a battering storm or moonless night.

But what has been a nightmare for sea captains has become a paradise for the sport diver. Not only are the wrecks themselves interesting—capsules of American history—but they also attract a variety of marine flora and fauna.

"Even if you hate ships you have got to be impressed when you see these wrecks underwater," says diver Shirley Kelley. "Because a ship belongs on top, when you see it underwater where is doesn't belong, it's an eerie feeling."

Many of the wrecks which used to lie in the state's ocean graveyard were of the pre-Civil War vintage. Time and the sea have taken their toll on these vessels and only an occasional wooden hulk remains to remind us of the era's majestic sailing schooners.

Photo by Ron Thrower

A diver swims by the wreckage of the U-352

The Civil War blockade runners have fared better in the shallow seas along the state's southern coast, where they tried to run the Union blockade of Wilmington.

"All wrecks change from year to year because of deterioration and winter storms that stir up the bottom," says Paul Goetz. "But the blockade runners which lie just off the beach are especially changeable. The natural movement of the sand up and down the beach will cover and uncover these wrecks from time to time."

The most famous wreck to lie in North Carolina's underwater graveyard is the ironclad U.S.S. Monitor. It was declared the nation's first marine sanctuary in 1975. Permission must be obtained from the Underwater Archaeology Branch at Fort Fisher to dive on the Monitor. It lies 16 miles off Cape Hatteras in 220 feet of water—a depth too risky for sport divers.

World War II wrecks

While divers have limited access to Civil War vessels, tankers and freighters sunk during World War II are abundant along the state's coast because of German U-boat activity.

"It's really kind of scary," says one veteran diver. "We all thought the war was being fought in Europe and the South Pacific, but it was actually right here on our doorstep."

During the first three months of 1942, Hitler's U-boat fleet downed over 50 vessels off the North Carolina coast alone. But by mid-April the United States began strengthening its defense and four German subs were sunk.

After World War II, better navigation techniques, shipbuilding methods and weather forecasting combined to reduce the number of ships victimized by the shoals and the storms. Only occasionally now does a vessel fall prey to the state's hazardous shoreline.

Today most divers prefer to dive on the World War II wrecks because they remain largely intact and are big enough to attract more marine life, says Dennis Regan, a diver and Sea Grant's marine advisory services recreation agent based on Roanoke Island.

In a Sea Grant publication, *Wreck Diving in North Carolina,* Regan briefly describes the popular wrecks accessible to the average diver. Some wrecks should not be approached, he says, because they lie in strong currents or waters over 110 feet deep—the limit for sport diving.

Regan says new wrecks are being discovered almost every year by commercial fishermen and divers. Fishermen locate them when their nets get caught in the wreckage or their catch is especially abundant over a particular area. On the other hand, divers will often use old charts and military records to pinpoint areas where a vessel may have gone down and then search the bottom for the remains. Whatever the method, "every now and then someone stumbles across a new one," Regan says.

But once a wreck is discovered, it is not always easy to find on the return trip. An experienced boat captain whose vessel is equipped with a Loran system for navigation and a sonic depth recorder is needed to find most wrecks.

"Finding a wreck 20 to 30 miles offshore is sometimes like looking for a needle in a haystack," says Ron Thrower. "It's nice to look at a chart and say that's where the wreck is, but there aren't any signs when you get there."

Several controversies have arisen about diving the wrecks off the North Carolina coast. One centers on whether divers should remove artifacts like brass portholes and gauges from the sunken vessels.

Artifacts

Some divers maintain that souvenir hunters and salvaging companies have destroyed the beauty of the wrecks and are hastening their deterioration.

"After a while it begins to show," Thrower says. "Especially when people take dynamite and blow holes in the wreck. The ocean will eventually destroy any wreck, but people are helping speed up the process and everybody is losing."

Other divers say the wrecks should be salvaged before they deteriorate and collapse and the portholes and navigation gauges are lost permanently.

But any wreck, within the three-mile state limit is state property once it has remained unclaimed more than 10 years. It is illegal to remove artifacts from these vessels without a contract or permit.

The only exception to this law is a blockade runner, The Modern Greece. A $1 permit from the Underwater Archeology Branch at Fort Fisher allows divers to retrieve unattached artifacts from around this wreck. But even then the state may claim any item a diver finds if it is of historical value.

"When divers first started diving the wrecks many of them were going out there just to rip off the vessels," says Leslie Bright, an archaeologist at Fort Fisher. "But now they're beginning to understand the historical significance of what we have there."

The U-325

Another controversial topic in North Carolina wreck diving is the U-352, a German submarine that lies in 115 feet of water about 26 miles south of the Beaufort Inlet. One armed torpedo protrudes from the sub's firing tube and four others are visible in storage racks.

Connecticut Senator Lowell Weicker drew national attention to the sub last year when he made a dive on the wreck and said it presented a "very real danger" to divers and fishermen. Weicker asked the U.S. Navy to investigate.

After the Navy reached an agreement with the West German government over the remains of the U-boat crew, the Germans gave the Navy permission to explore and destroy the wreck if necessary. The Navy found the ordnance dangerous and is presently deciding whether the sub should be destroyed or whether an attempt should be made to remove the torpedoes.

Many N.C. divers maintain the Navy and Senator Weicker are exaggerating the wreck's danger and feel that destruction of it is unnecessary.

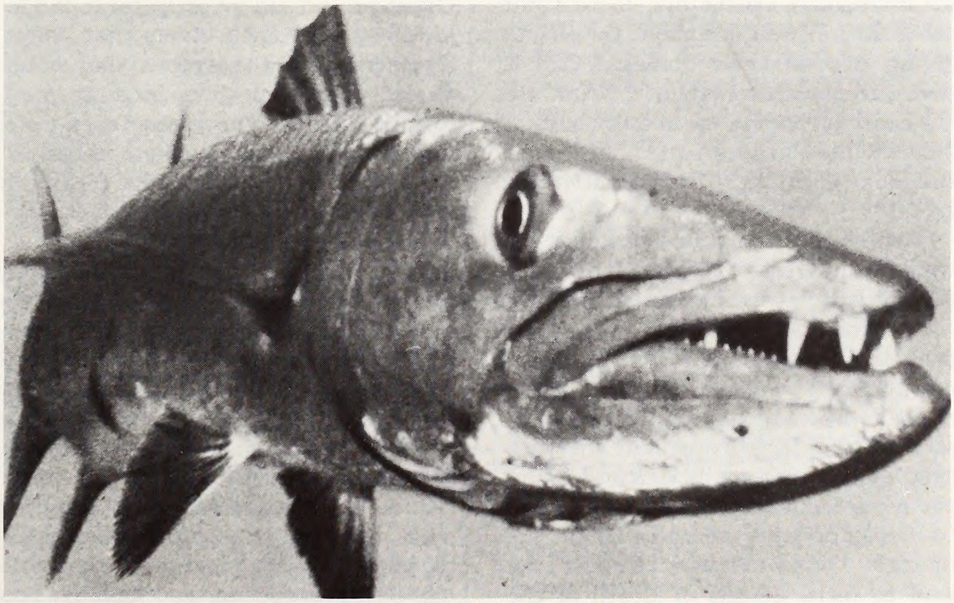
"That particular wreck is so deep you only have about 15 minutes of bottom time. I would say if you took 100 divers that had dived on the sub that you might find one of them that could tell you where that torpedo was," says Eastep. "Yes, there is a chance some diver might go down there and set that torpedo off. But there is also the possibility when you are walking down the street you'll get hit by a car."

Meanwhile, the U-352 has become one of the most frequently visited wrecks in the coastal graveyard.

The German sub is not the only wreck known to have carried ordnance, so divers should exert caution when diving on any wreck off the coast.

While wreck diving in North Carolina has aroused some controversy, the wrecks are still the most popular spots to dive because of the valuable history and biology lessons they offer to those willing to visit their graves.

Photo by Ron Thrower



A ferocious-looking barracuda grins for the camera

Women are diving, too!

Mention SCUBA diving and many people think of a strapping Lloyd Bridges.

Rarely does anyone think of women donning SCUBA equipment, slipping beneath the waves and exploring the ocean depths. But they do, both for sport and as professionals.

According to a February issue of the National Oceanic and Atmospheric Administration's magazine, about 25 percent of the country's divers are women. Their numbers are increasing by 20 percent annually.

Though more women are diving, there are many more who could be diving but won't because of misconceptions about the sport.

Shirley Kelley, an advocate of women diving and a member of the national YMCA's subcommittee on women's activities, believes that most women begin diving at the urging of male friends or relatives. She also maintains many women automatically assume they can't dive because they think the sport is largely a masculine one that requires great strength. But equipment has gotten lighter and the weightlessness under water acts as an equalizer between the sexes.

Fear of the marine life is a common reason women cite for not diving. But diving instructors quickly refute that argument by emphasizing that sea creatures, including sharks, will rarely bother anyone unless they are bothered first.

Kelley maintains diving is largely psychological and that self-confidence can go a long way toward making women and men better divers.

"Diving is certainly not as complicated as driving a car and not nearly as dangerous," Kelley says. "Yet nearly every woman in this country can drive and never gives a thought to the danger involved."

Kelley and others feel that as more people know and understand diving there will be fewer misconceptions about the sport. Many women who take a diving course and make several ocean dives wonder why they ever balked at the beginning.

"My first ocean dive was in the Virgin Islands and it was one of the most emotional experiences of my life," Kelley says. "My husband doesn't dive and here I was sitting on the edge of this boat alone. Everybody in my dive party had gone in. I thought, what have I done? I'm going to go down there and get killed. This whole thing is the dumbest thing I've ever thought of.

"But I went over the side and bubbles were everywhere. I was dizzy because I was upside down. Then the bubbles cleared. I've never seen anything like it in my life. The colors, the forms, the fish— everything was beautiful—I was hooked from then on."

Photo by Marshall Wyatt

Shirley Kelley

Does diving affect women differently?

As more women become divers, they are asking dive instructors, doctors and other divers questions about the effects diving has on their bodies: "Can I dive during menstruation?" "What are the consequences to me and my baby if I dive while I'm pregnant?" "If I'm on the pill, will diving affect me differently?"

These are important questions for women and researchers are now conducting studies to find the answers.

Researchers with two Sea Grant programs have studied diving's effect on pregnant women. At the Texas A&M University Sea Grant program, scientists subjected pregnant sheep to simulated diving conditions and found the fetus tends to be more susceptible to decompression sickness than the mother. Decompression sickness can lead to birth defects or death of the fetus.

In the University of Florida Sea Grant project, an investigator found in a survey of women divers that about five percent of the women who dived during pregnancy gave birth to malformed infants. The percentages were higher for deep dives where about 12 percent of the women who dived at depths of more than 100 feet had babies with birth defects.

While these studies seem to say that pregnant women who dive may harm their unborn children, the research is inconclusive and investigators say women who have dived during pregnancy should not be alarmed.

Nevertheless, pregnant women are warned to limit dives to 60 feet, limit the duration underwater to one-half what the Navy decompression tables recommend, and avoid strenuous diving, hyperventilation and chilling.

Dr. Susan Bangasser, a SCUBA instructor and biochemist for the National Association of Underwater Instructors (NAUI), has researched the effects on women of diving during menstruation and while taking birth control pills. She found that the advisability of diving during menstruation depends on how the woman feels. If a woman has cramps, is nauseated or feels unusually fatigued she should not dive. Also the tendency toward water retention in the body during the menstrual period may increase the risk of decompression sickness for women.

Birth control pills have also been linked to increased occurrence of decompression sickness. Researchers suggest that while taking birth control pills and during menstruation (and sometimes several days in advance) women use the no-decompression limits of the navy dive tables conservatively.

THE BACK PAGE

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Shark creole. French-fried squid. Eel salad. Forget their slightly unsavory reputations— the sharks, squid and eel proved eminently edible at the third annual "Strange Seafoods Spectacular," held August 16 in Beaufort.

The festival, organized by the Hampton Mariners Museum in Beaufort, was designed to give some neglected seafoods a little public exposure. Cooks and seafood experts from the area, including a group of Sea Grant food science technicians from the North Carolina State University Seafood Lab in Morehead City, prepared the food and served it from warmers set up in a courtyard near the museum.

The expected crowd of a few hundred people didn't show up. The unexpected crowd of over a thousand, however, did.

Bob Hines, Sea Grant's marine advisory agent in the Morehead City area, watched the eight pounds of rock shrimp he'd broiled disappear in less than 15 minutes. A seafood pizza, prepared by Joyce Taylor from the seafood lab, played a new variation on a traditional theme: instead of sausage and mushrooms, flaked fish and shellfish.

The rest of the menu? Among the most popular dishes were eel Newburg, sea urchin eggs, rock shrimp casserole and batter-fried ray.

The museum has printed a complete set of recipes for all 38 of the dishes served at the festival. The booklet costs $2 and can be obtained by writing the Hampton Mariners Museum, 120 Turner St., Beaufort, N. C. 28516.

In recent years a seafood delicacy, swordfish, has been found off the North Carolina coast and a few fishermen are now beginning to cash in on this treasure.

Jim Bahen, a Sea Grant marine advisory agent in the Wilmington area, has helped several commercial fishermen at Wrightsville Beach rig their boats for swordfishing. With swordfish fetching between $1.65 and $2.25 a pound at the market, fishermen are being paid handsomely for the investment it takes to catch the 100- to 700-pound fish.

Bahen says the market for swordfish is primarily in New England, but a few local retailers and restaurant owners are also purchasing it. The fish, sometimes called the "prime rib of the sea," is cut into steaks that have pleasant texture and flavor.

Bahen is also helping recreational fishermen to land swordfish and at least one fisherman has caught a 500-pounder off the North Carolina coast. Swordfish usually can be found 90 to 150 miles off the state's shoreline in the deep waters of the warm Gulf Stream.

Researchers are asking recreational and charter boat fishermen, along with commercial long liners, for a little help these days in their study of large game fish such as blue marlin, white marlin, sailfish, hammerjack and tuna.

Sea Grant agent Jim Bahen is asking on behalf of researchers that sport fishermen tag their catches if they plan to release them. That way, if the fish is caught again, scientists will know how far the fish has traveled, its weight gain and other vital statistics.

Fishermen who catch a fish that already has been tagged are asked to send the tag to the address listed on the tag, along with information about where the fish was caught and its weight and length.

If you would like to help researchers, you may get a free tagging kit by contacting Jim Bahen at the North Carolina Marine Resources Center at Fort Fisher.

Those sure-footed off-road vehicles (ORVs) can make tracks almost anywhere. And that, according to some people in Nags Head, is just the trouble.

Since 1974, Nags Head has regulated the use of ORVs on the town's beaches and barrier dunes. Residents hoped that the rules would protect the grasses that help anchor the dunes and stabilize the shoreline.

This summer, after citizens had once again met and voiced concern over ORVs, Nags Head lopped a month off each end of its beach-driving season, leaving only the months between Oct. 1 and May 1 open to beach traffic.

After hearing an earful of pros and cons about ORVs, the town's commissioners decided that some scientific know-how might help settle the debate.

That's where Paul Hosier came in. Hosier, a Sea Grant researcher, has been studying the effects of ORVs on the grasses and dunes at Cape Hatteras. He has found that, although stands of dune grass can recover from occasional traffic, constant or regular tramplings quickly kill the grasses and bare the dunes to the wind. Hosier is trying to determine exactly how much driving the grasses can stand.

Nags Head asked Hosier to expand his research to include a two-mile stretch of beach at the town's southern end, an area the commissioners made off-limits to ORVs. The protected stretch is adjacent to some well-traveled shoreline near one of the town's beach-access ramps.

With samples from both protected

Continued on next page

and unprotected parts of the same shoreline, Hosier expects some telling data from his research at Nags Head. And the commissioners expect to have some facts to lean on when, sometime down the road, ORVs wheel onto the agenda again.

If you are planning to build along the beach, you'll need to know about some new restrictions. The Coastal Resources Commission (CRC) has recently revised its regulations governing development in ocean hazard areas.

Spencer Rogers, Sea Grant's coastal engineering specialist, studied the annual rate of erosion and the potential for major storm damage along the beach. Rogers and other researchers used aerial photographs of the shoreline and on-site observations to determine which beach front areas were subject to major erosion. The study was submitted to the CRC and changes were made in July.

Building or development in these areas will no longer be permitted seaward of the primary dune; specific construction standards apply. The primary dune is the first sand dune with an elevation equal to the 100-year flood level plus six feet. Under the former regulations, development was permitted immediately behind the lower frontal dunes.

The CRC also made other changes in the Coastal Area Management Act (CAMA). Builders and developers should check with local CAMA permit officers before building.

Sea Grant offers two free publications of special interest to SCUBA divers. *Wreck Diving in North Carolina*, by Dennis Regan and Virginia Worthington, is a directory of 42 shipwrecks off the North Carolina coast which are most popular among divers. The 16-page booklet gives locations, a brief description and history of each of the wrecks. It also includes a directory of North Carolina dive shops and a section on safety.

If you're a SCUBA diver, the *Diver's Emergency Information* card could save your life. A water-resistant, wallet-sized card, it alerts medical personnel to the fact that you could be suffering from decompression sickness and gives emergency phone numbers and the locations of nearby decompression facilities. One side of the card provides space for the diver's name, address, next of kin, blood type and drug sensitivities. It's published by South Carolina Sea Grant.

Planning a trip to the North Carolina coast? Sea Grant's new 28-page booklet, *Vacation and weather guide to coastal North Carolina*, may be just what you need. This 28-page booklet features information on coastal recreation, including boating, camping, bird watching, surfing and hang gliding. A detailed fishing section outlines tips on fishing for the most common freshwater, offshore and inshore species. The booklet also provides year-round weather data—including charts on sailing winds and offshore weather, a list of related publications and a series of coastal maps. It is published jointly by Sea Grant and the Environmental Data and Information Service.

Learn how to get more nutrition for your money by using high protein, low calorie fish flakes for cooking. *Fish Flakes: seafood stretchers*, is a fold-out flyer which tells you how to flake fish at home in six easy steps and gives two tested recipes which use the flakes.

For your single free copy of any of the publications listed above, write Sea Grant, Box 5001, Raleigh, North Carolina 27650. If you wish to order any of the publications in bulk, contact the Sea Grant office for information on charges.

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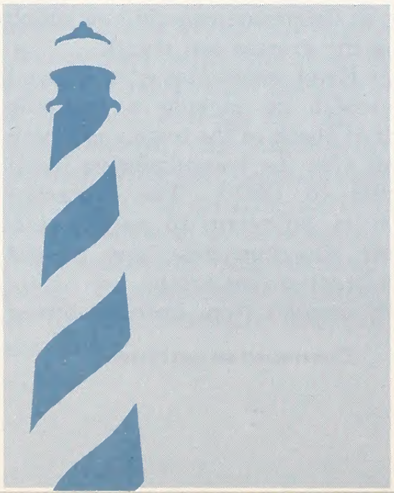

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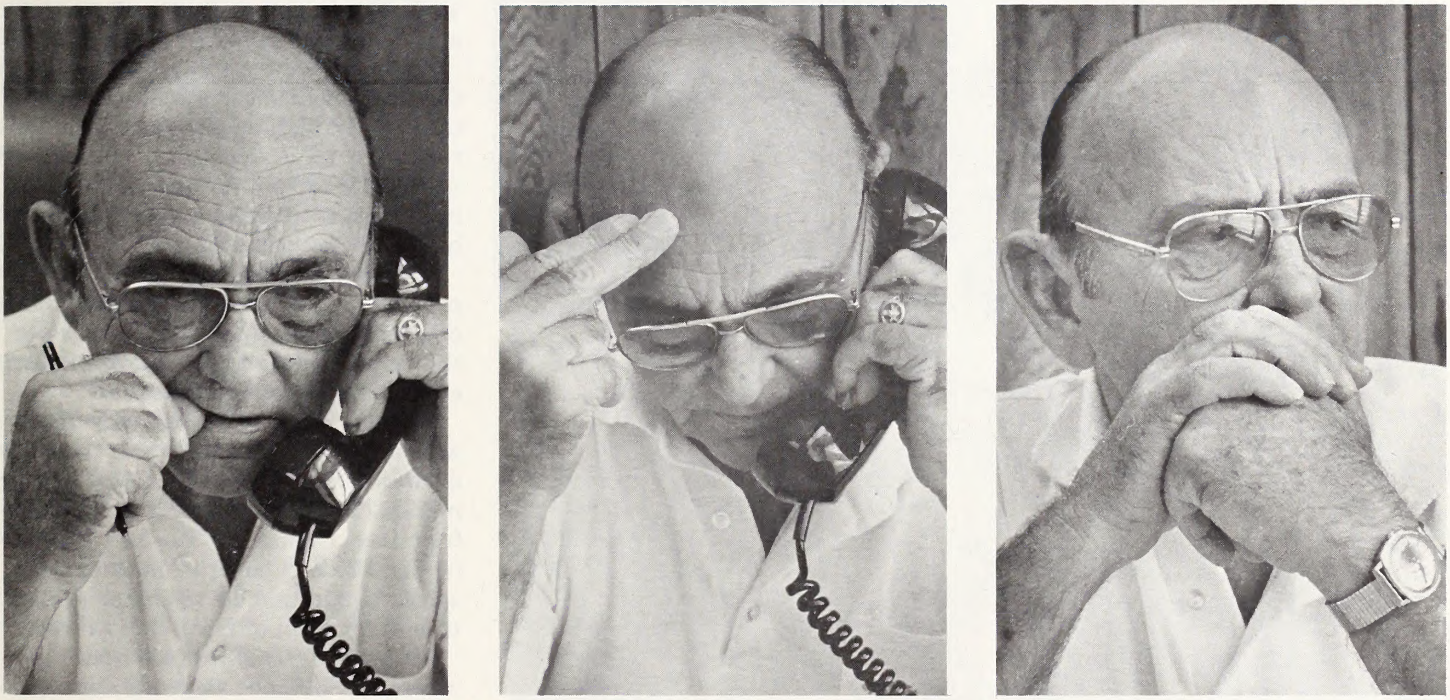


Reaching a New England fishery, Tillett inquires about squid, comes up empty, and ponders his next move

'Captain Hughes' Tillett: advice seasoned with salt

By 10 o'clock on Thursday morning, after two hours of telephoning up and down the East Coast on a wild-goose chase for squid, Hughes Tillett has the telephone in a stranglehold.

He spins another number, honeys his voice to a secretary somewhere in New England, states his business, gets nowhere, and hangs up with another number to jot down.

"Everybody gives me somebody else to call," he grumbles.

Now hold on. Any fisherman who has known Tillett since he worked a boat out of Wanchese, fishing the waters from Ocracoke to Currituck, can tell you there's something cockeyed about this scene.

Since when did Hughes Tillett need a telephone to hunt squid? They've always been the ten-armed, saucer-eyed "trash" that you hauled up when you went floundering—hardly worth the effort to box.

"Fishing in North Carolina has changed," he argues, poking his pen at a notepad. "There were always good years and bad years, but there wasn't all this new gear to keep up with, and there wasn't as much competition as there is now. Now that there's getting to be a market for these squid, they might turn out to be something these guys can work, so that everybody doesn't have to work the same species."

Tillett is one of Sea Grant's marine advisory agents. Advising coastal residents, especially fishermen, requires a lot of legwork and a downright pig-headed determination to get the facts. That's why he spends a lot of time on the telephone.

He's hunting squid because Malcolm Daniels called him last night, woke him up and asked him for help. Daniels, a fisherman in Wanchese, has rigged a brand-new trawler just for squid. It even has an on-board freezer, the first Tillett has seen in the Outer Banks area.

The Japanese, it seems, are offering

Continued on next page

a good price for squid, so long as it's frozen almost as quickly as it's hauled aboard. In Japan, squid are known as a high-protein, delicately flavored seafood, not as trash.

After a test run, the "Captain Malc" is ready for serious squidding. But nobody can say where the beasts are all holed up. The Point Judith Fishing Cooperative in New England doesn't know, even though, in August, most of the squid are likely to be somewhere in northern waters. And the out-of-state fisheries people and Sea Grant agents don't know either. At ten-thirty, Tillett gives up and rocks back in his chair.

"The squid is an under-utilized species," he explains. "People in this country just don't know much about them."

Around the docks and fish houses, Tillett peppers his conversation with enough ripe expletives to make the tatoos on a sailor blush. Nobody raises an eyebrow. But "under-utilized" sticks out like a gin bottle at a deacon's meeting.

It's the buzz-word these days. Under-utilized sources of energy, under-utilized species of fish. It's about the only bit of bureaucratic jargon to sprout in Tillett's vocabulary since he took his "government job" with Sea Grant in 1974. As a matter of fact, there's nothing very official about "Captain Hughes." Sure, he drives a car with state plates and uses an office in the N. C. Marine Resources Center on Roanoke Island. But he still lives in Wanchese, spends his spare time fishing, and insists that his home phone number be printed on his business cards.

Tillett spreading word about hydraulic gear

He believes it's his job to support the sort of initiative it takes for a fisherman to give up some of his old habits and re-rig his mind and equipment for a different catch.

"If they don't find something new to work, it's going to be the fishermen who are under-utilized," he says.

Leaving a few messages with agencies that might hear something about the squid, Tillett climbs into his car for the drive to a sometime fisherman's house in Manteo. The man and his sons need help stitching a line into the tail bag of their shrimp net.

"We get all kinds of requests from people," he explains. "There are a lot of people, young people, moving into the area, wanting to know almost everything about the coast."

The backseat of his car is stacked with publications, and he uses them to answer many of the requests for information. They cover almost everything from eel fishing to storms. But if neither Tillett nor the booklets can answer a question, he refers the person to another agent or researcher who can.

Helping a seasoned pro—the guy whose livelihood depends on the vagaries of weather, water and fish—is not quite so simple.

"They told me, when I came to work with Sea Grant, to just work my forty hours a week, and that was enough. But I knew when I took the job that I was going to get a lot of calls at home. When else is a fisherman, who works all day in a boat, going to call you?"

To have the answers when the calls do come, Tillett combs the industry publications for news about gear, processing and fishing techniques.

"A fisherman who goes out and works all day long, and gets home after dark, a lot of the time, he's just too tired to read and keep up with everything," he says. "They call me, when they've got a problem, and I try to do their reading for them."

But the problems of the fisherman are more than just technical or trade problems, these days. People, politics and pollution have seeped steadily into the coastal area in recent years, taxing the region's resources and the patience of its natives. To keep up with the influx, Tillett attends meetings and conferences, asking what, if anything, can be done to protect the fishermen and the resources on which they depend.

If you're looking for a calm, private lunch, don't go out to eat with Hughes Tillett in Manteo. No matter which joint he takes you to, it seems as if he knows everybody with a sunburn more than three weeks deep. The restaurant owner's son comes by the table to say he's bought a new trawler. A brace of tanned fishermen report on the scallop catch. In return, everybody hears about the "Captain Malc" and its new freezer.

Before long, it's pretty obvious that he intends to work right through lunch. But that's part of his style—work tucked away in a large measure of socializing.

"Hello here," he calls, "what are you up to, you old lazy so-and-so?"

The fisherman grins, returns the compliment, and by the time the waitress comes for the order, the miseries of this year's shrimp season have been compared to the worst in memory.

Tillett gives the waitress a hard time about the menu, which is written to catch the tourist's eye.

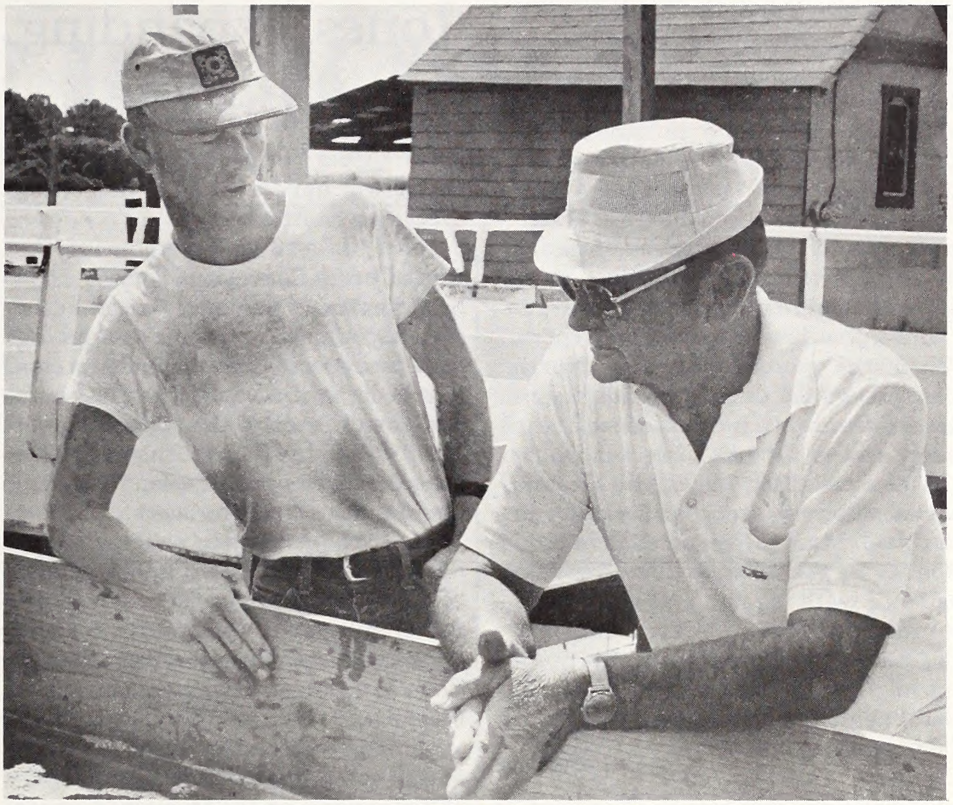
"The special is popcorn shrimp," he reads. "Now what in the world are popcorn shrimp? I never heard of that species."

Maybe the obvious question to ask him is this: Do we really need Hughes Tillett, marine advisory agent? Why not let the fishermen and coastal residents look out for themselves?

The question makes him grin.

"That's what those fishermen are always riding me about," he says. "Some days, I'll go down to see some of them, and they say, 'Are you down here loafin' on our tax money again?' But let a little time pass before I go back, and the next time I'm down there, they're saying, 'Hey, Hughes, what good are you, if you don't come around to help us?' It's just their way of kidding me."

But the question has occurred to him before, and he sums up his answer this way:


Mike Cox fills Tillett in on success of new aerator in peeler-crab trough

"Fishing just isn't as simple as it used to be," he says. "And unless the fishermen get some help, they're going to have a hard time making it."

A few years ago, he explains, fishing in North Carolina was stalled back where agriculture was in the first part of the century: dwindling resources, antiquated methods, and youngsters who tended to desert the family business for more promising careers. Extension work made the new methods and technology available to farmers. Tillett thinks Sea Grant is, at last, providing that service for fishermen.

But he thinks no advice at all is better than the wrong kind, or the right kind from the wrong person. The idea of an outsider coming down to the docks, set on changing things overnight, is enough to make him chuckle.

"If they don't know you, they're not going to have a damn thing to do with you," he says. "It's hard enough when they know you."

They all know Captain Hughes. He grew up in Wanchese, helping his father work long-net trawlers, and has never stayed away from the area any longer than he had to.

"I enjoy working with fishermen because I've been one," he says. "I came here in the first place because I saw a chance to help fishermen."

He also came, he adds, because fishing is just too tough on both body and soul. Murderously tough. He believes that one way he can help fishermen is by replacing some of the back-breaking, hand labor with modern equipment that saves time and muscle. When he came to work as Sea Grant's second advisory agent in 1974, hydraulic and electric pot-pullers and net-winders were rare. Now, they are common.

"Fishermen have changed a lot from the way they used to be," he says. "When I first started working with those pot pullers, fishermen were real slow to try it. They were slow to put their hard-earned dollars into things like that. You just have to keep chipping away. You get one to try it, and maybe help him put it on his boat, and then he saves himself some trouble, and the others start asking, 'How can I get one of those?'"

Back at the office, Diann Jones, the secretary and inboard motor of the Sea Grant office in the Center, has a fistful

Continued on next page

of notes for Tillett. A crabber from Cape Hatteras wants to know how he can borrow money to buy equipment. Somebody is looking for eel pots, and somebody else wants to buy a net. Tillett takes the notes back to his desk and studies them. He reads one twice: "On a good day, eight boxes." Translated from Diann's shorthand, it means that up North, they're getting eight boxes of squid on a good day.

It's not a very encouraging report. When the squid drift into North Carolina waters during the fall, flounder fishermen often catch enough in a single day to fill 100 boxes.

Tillett calls Bob Hines, Sea Grant's newest advisory agent, at his office in the N. C. Marine Resources Center on Bogue Banks. Hines has had experience with squid, and may have some contacts Tillett doesn't. Together, they go to work on the problem of how to steer a crew of North Carolina fishermen toward a decent day's work.

Whatever their working styles, all the Sea Grant advisory agents and specialists have a goal in common: They are trying to take the best available ideas and the latest research and put them to work solving problems.

—Like Hughes Tillett, Jim Bahen (N. C. Marine Resources Center/Ft. Fisher, 458-5498) works with commercial fishermen. Bahen also advises sport fishermen and conducts classes.

—Sea Grant's newest advisory agent, Bob Hines (N. C. Marine Resources Center, Bogue Banks, 726-0125), is confronting problems at several levels of the seafood industry: fishing, processing and marketing.

—Dennis Regan (N. C. Marine Resources Center/Roanoke Island, 473-3937) is an agent concentrating on recreation and tourism.

Sea Grant's advisory service also includes the NCSU Seafood Lab in Morehead City (726-7341); the eel farm near Aurora (322-4054); marine education specialist Lundie Mauldin in Raleigh (737-2454); economist and recreation specialist Leon Abbas in Raleigh (737-2454); and coastal engineering specialist Spencer Rogers at Ft. Fisher (458-5780).

Jones expanding advisory service

Advice. J. C. Jones has been in the business of giving it long enough to know that a "babe in arms" like Sea Grant will have a tough time getting everybody's attention.

Jones is a 23-year veteran of the Agricultural Extension Service, and he's watched it become a fixture in the state's communities. But he's an Ag man whose roots have found water—he's been both a captain in the Navy and the director of the state Office of Marine Affairs. He is shaping from those experiences a plan for Sea Grant's own extension work.

"I think it's already working well," he says of the marine advisory services. "But there are things we've got to do. Sea Grant got its start partly because of the success of Agricultural Extension. In a lot of ways, we can follow their lead."

Hoping to make Sea Grant's imprint on the coast as indelible as Agricultural Extension's on the farmlands, Jones spells out three goals for the advisory services program:

—More agents. Jones would like to triple the number of Sea Grant field agents from four to 12.

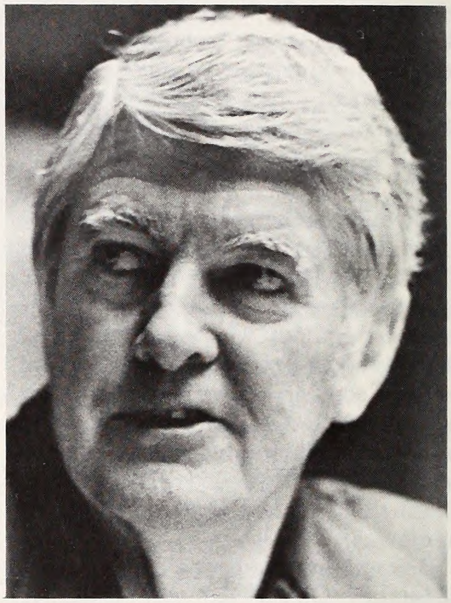
"I'd like to see at least one person who is strong in marketing and economics," he says, "and we need some additional fisheries expertise. There are some counties that could support agents of their own. Carteret, for example, could support an agent just for that county."

—A new seafood lab. Jones has already found space for a small lab in the N. C. Marine Resources Center on Roanoke Island. Like the North Carolina State University Seafood Lab in Morehead City, the smaller lab would study new ways to prepare and process seafoods.

"I'd like to see a technician up there manning that lab by the end of the year, if we can find funding," he says. "We'll need that expertise, especially when the Wanchese Industrial Park develops."

—Stronger local support. Sea Grant agents are finding plenty to do, but Jones would like to see more support for the program from coastal communities.

"If a county gets behind a program, and supports it, then the people in the county begin to think of the program as theirs. They take more interest. This is what Ag Extension has done. Every county provides office space and some funding for the program."



Jones coaching advisory agents

He has already directed his agents to start building that support.

"I want them to meet with the county commissioners each month, as the Ag agents do. I would like to see them develop an advisory board, made up of local citizens in each county, that would point out things that agents should be working on. Also, we must establish a clientele, a group of people the agents call on regularly."

Jones says that the extension work with farmers has, over the years, developed a well-tested model for extension work that Sea Grant agents can adopt for their work with fishermen.

But working with fishermen is only a part of the advisory agents' job. North Carolina's rapidly developing coast seems to break out with a new set of growing pains each year.

"What we have to do is help see that the growth is orderly," Jones says, "and that our fragile areas are protected.

"Our role is to provide all the research available to the people who make decisions. We do not advocate. Occasionally, we make recommendations, but this is true only after a lot of sound research has been done, and we base our recommendations on that."

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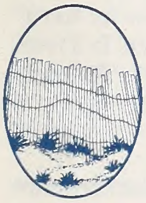


Spencer Rogers, Sea Grant's coastal engineer, spent September surveying the damage from two hurricanes, David and Frederick. David, which made landfall in South Carolina, was downgraded to a tropical storm before moving into North Carolina with wind gusts up to 70 mph and a storm surge two feet above normal. Rogers said some erosion occurred at Wrightsville Beach, Topsail Beach, Yaupon Beach and Ocean Isle, but damage was no more severe than that from a northeaster.

Rogers and Sea Grant researcher Jerry Machemehl found things much different in Mobile Bay, Alabama, after Hurricane Frederick. Strong winds toppled entire pine forests and mobile homes were overturned. Machemehl noted that beachfront homes with load-bearing walls built parallel to the beach were often destroyed because the strong storm surge hit these walls broadside and collapsed them.

Rogers said that other homes were destroyed because their pilings were not deep enough. He said that in many of these cases the piling depth would have met North Carolina building codes.

After viewing the destruction from Frederick, both men warned that North Carolinians should not be lulled into thinking all storms will be like David. Rogers said even though North Carolina codes for coastal construction are more stringent than Alabama codes, the state still isn't ready for the type of hurricane that struck Alabama.

Sea Grant researcher Bobby Carlile came to the rescue of the Camden Middle School recently when Camden County health officials found the school's septic system was malfunctioning. Health officials were going to require the school to build its own small treatment plant at a cost of $50,000 to $70,000. But Carlile found an area in the schoolyard suitable for a modified version of his low-pressure pipe system. The system can be built at a cost of $5,000 to $10,000. The low-pressure system is being used more and more as an alternative to the conventional septic tank system in eastern North Carolina, where the water table is high and soils do not allow good filtration.

Carlile expects to be working with more school systems throughout the state to improve their disposal systems. He says about 600 schools must upgrade their systems to meet state and federal water quality standards.

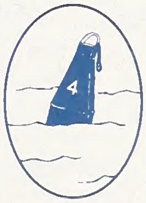
The well-traveled cownose ray, which has been frozen into slabs and shipped to Europe, may take its next trip abroad in cans.

Technicians at the NCSU Seafood Lab in Morehead City are blending ray meat into a tomato sauce and sealing the seafood into 7½-ounce cans. So far, the product is getting high marks.

After sampling ray canned in several different liquids—including brine, oil and sauces—technicians rated the tomato-sauce version highest in quality. They describe the product as flavorful and attractive, with a firm texture. It is similar, they say, to other canned seafoods.

One North Carolina businessman plans to take samples to Taiwan, where he will try to find markets for the ray.

The work with canned ray is part of an extended project the lab has conducted to research and market some of the state's under-used seafoods. Skates and rays have been considered "trash fish" by most Americans, even though the fish are delicacies in much of Europe and the Orient. Marketing the frozen ray in Europe has been difficult, technicians say, because foreign distributors feel the reddish color of North Carolina ray meat won't be as popular with their customers as the white meat of the European rays.



Researchers know that grasses planted along the shores of sounds and estuaries can help prevent erosion. But in some areas, strong or frequent waves wipe out plantings and continue to chew away the soil. The question has been, how can anyone predict when and where the strong waves will occur?

At least part of the answer is blowing in the wind. Because wind rumples water into waves, scientists have been able to formulate ways to project, from wind speed and direction, waves of a certain size or frequency. Two Sea Grant researchers, Ernie Knowles and Bob Weisberg, have used these techniques to predict waves in several North Carolina sounds. The methods take into account not only wind speeds, but "fetch" (the distance wind blows over water), water depth and other factors. Using sophisticated wave-monitoring gear, Knowles and Weisberg have recorded thousands of waves, correlated the data with wind records, and compared the findings to their predictions.

After nine months of collecting and comparing, Knowles reports that their methods have very accurately predicted the "period," or length of time between predominant waves in the sounds. In fact, the predictions were so close that most waves only missed their projected timetables by a fraction of a second.

Continued on next page

Knowles is also pleased with the accuracy of methods he and Weisberg are using to measure and predict wave height. He believes that these forecasting techniques will help researchers compose an atlas of the state's sounds, showing areas especially susceptible to strong waves. Using that atlas, Knowles says, landowners will know better how to choose the right protection for their shorelines.

Fishermen are getting help that is out of this world—from satellites. Jim Bahen, a Sea Grant marine advisory agent in the Wilmington area, has been working with the National Oceanic and Atmospheric Administration's National Weather Service and National Environmental Satellite Service to provide fishermen information on the location of the Gulf Stream off the North Carolina coast.

Longline fishermen who fish for warm-water species like swordfish and marlin need to know the location of the Gulf Stream and its eddies. This has presented problems in the past, Bahen said, because the Gulf Stream changes location often, and fishermen spend time and fuel looking for it.

Now, through infrared satellite photography, the exact location of the Gulf Stream and its eddies can be pinpointed. The location is being broadcast to fishermen three times a week over the VHF radio and television stations.

Since the Fishery Conservation and Management Act (FCMA) went into effect in 1976, the concept of the 200-mile fisheries conservation zone has become an accepted international standard. There are now eight regional councils working on plans to manage more than 70 fisheries in the U.S. Beginning in early 1980, the public will have a chance to comment on plans being drawn up for North Carolina fisheries.

The South Atlantic Fisheries Management council has produced a 28-minute slide/tape show which explains how the 200-mile limit and the management plans work. Sea Grant fisheries agents and recreation specialist Leon Abbas have offered to show the film and discuss the FCMA with interested groups. For more information, contact Abbas in Raleigh or any of the agents at the coast.

Lundie Mauldin, Sea Grant's marine education specialist, has won the 1979 governor's award for conservation communication. The award, made by the N.C. Wildlife Federation, is presented to the organization or individual who "best creates a public awareness of North Carolina wildlife and conservation."

The awards committee cited Mauldin's efforts, through workshops, personal contacts and publications, to inform the state's educators about coastal conservation.

Mauldin has also been elected president of the Mid-Atlantic Marine Education Association, a group of educators who promote study of the marine environment. She was elected during the association's annual conference, held Oct. 5 and 6 in Manteo.

So you fish for fun. Or maybe you're trying to make a living as a commercial fisherman. Either way, you're probably interested in cutting your costs. Hanging your own nets is one way to do it. Sea Grant has recently published a 16-page, illustrated booklet that may help. "How to Hang a Gill Net" presents step-by-step procedures for hanging a typical, efficient gill net. It's free. Write Sea Grant, Box 5001, Raleigh, North Carolina 27650.

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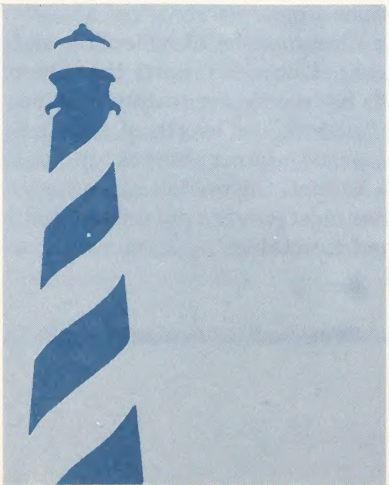

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COASTWATCH

Coastal transportation—a rose or a thorn?

Editor's note: Water is a natural part of the coastal setting—the ocean, the rivers, the sounds, the inlets. And people who live along the coast have found the waters to be both an aid and a hindrance to travel. In a two-part series, Coastwatch will examine some of the problems inherent in coastal transportation. The October issue will discuss the means of spanning these bodies of water: ferries and bridges.

From the pontoon drawbridge at Sunset Beach to the three-mile, concrete span bridge at Oregon Inlet, transportation officials have tried to link coastal North Carolina across a labyrinth of rivers, inlets and sounds.

Transportation has been a controversial topic among coastal residents and bridges have often been part of the controversy as residents have fought for and against their placement.

William F. Caddell, assistant secretary of planning at the N.C. Department of Transportation, says the N.C. Board of Transportation decides when and where bridges will be built.

The department's planning division recommends certain locations for bridges based on studies, Caddell says. But the public also plays a role in bridge planning, he added.

"Anyone can request a new bridge," Caddell says. "These requests are what the department considers candidate projects. We have hundreds of them."

Also, the board of transportation has public meetings throughout the state so citizens and local government officials can tell the board their trans-

Continued on next page

Photo by N. C. Dept. of Transportation

Cape Fear Memorial Bridge near Wilmington portation priorities, he says.

Enough clamor from the public can go a long way toward getting a transportation project placed on the board's seven-year schedule for completion, he indicated.

"Usually when there is a lot of outcry from an area for a bridge or a road that is an indication there is a certain amount of need," Caddell says. But, he adds, careful studies are made of all projects to determine their social, economic and environmental benefits before funds are earmarked.

No bridge, however, can be built over navigable waters without the consent of the U.S. Coast Guard.

Once a bridge is completed, transportation officials say the lifespan of that bridge is 40 to 50 years in the coastal environment. "After that amount of time, bridge supports begin to deteriorate and usually the bridge is posted for less than legal loads until it can be replaced, says Jimmy Lee, head of the transportation department's bridge maintenance unit.

How fast a bridge is replaced depends on such factors as its general location, the alternate routes available and the number of school buses that use the bridge, Caddell says.

"All bridges in the state are inspected every two years and none of them are unsafe," Caddell says. "We do have some that are posted, but these are not unsafe as long as people observe the posted limits."

Few bridges are posted for weight limits along major routes and none of these restrict commercial traffic, Caddell adds.

While officials must decide when and where to build a bridge, they also must decide what type of bridge is most suitable for the waterway being spanned.

Lee says the drawbridge is one type of bridge that allows road traffic and water traffic to alternately cross the same waterway.

Four types of drawbridges are currently being used by the department of transportation in coastal North Carolina.

One of these is the outdated pontoon bridge that connects Sunset Beach with Brunswick County. The opening section of this one-lane bridge floats on pontoons. It is opened by a cable which pulls the bridge to the bank.

Lee says this bridge, slated for replacement, is opened more than any other state-operated drawbridge because it does not allow any water traffic to pass beneath it. Other types of drawbridges—swing, bascula and vertical lift—allow smaller craft to pass beneath their movable spans.

Swing bridges, such as the one that crosses Bogue Sound from Morehead City to Atlantic Beach, open by rotating 90° on a center support. Bascula bridges divide in the middle with each side rising to a vertical position.

The fourth type of bridge, the vertical lift, can be seen in Wilmington where U.S. 17 crosses the Cape Fear River. Lee says this bridge, built to accommodate the passage of large ocean-going vessels, rises between two towers.

There are 22 drawbridges in full-time operation by the state, Lee says. Four drawbridges are on call and water traffic must give the state 24 hours notice for a tender to be present to open these bridges.

The U.S. Army Corps of Engineers also operates several of its own drawbridges in the state.

It is usually more expensive to build, maintain and operate a drawbridge than a span bridge, but span bridges cannot be built everywhere, Lee says. There is not always enough undeveloped land available on each side of the river or waterway to allow engineers the proper slope necessary to build such high-level bridges.

The coast is known to be unstable and the clash between shifting sands and permanent structures can result in

Photo by Mary Day Mordecai

Howard Holden opens pontoon bridge at Sunset Beach a costly expenditure in terms of bridge maintenance, transportation officials have found.

A thorn in the transportation department's side since its completion, the multi-million-dollar Herbert C. Bonner Bridge has cost the state additional millions to keep the bridge standing over the shifting Oregon Inlet.

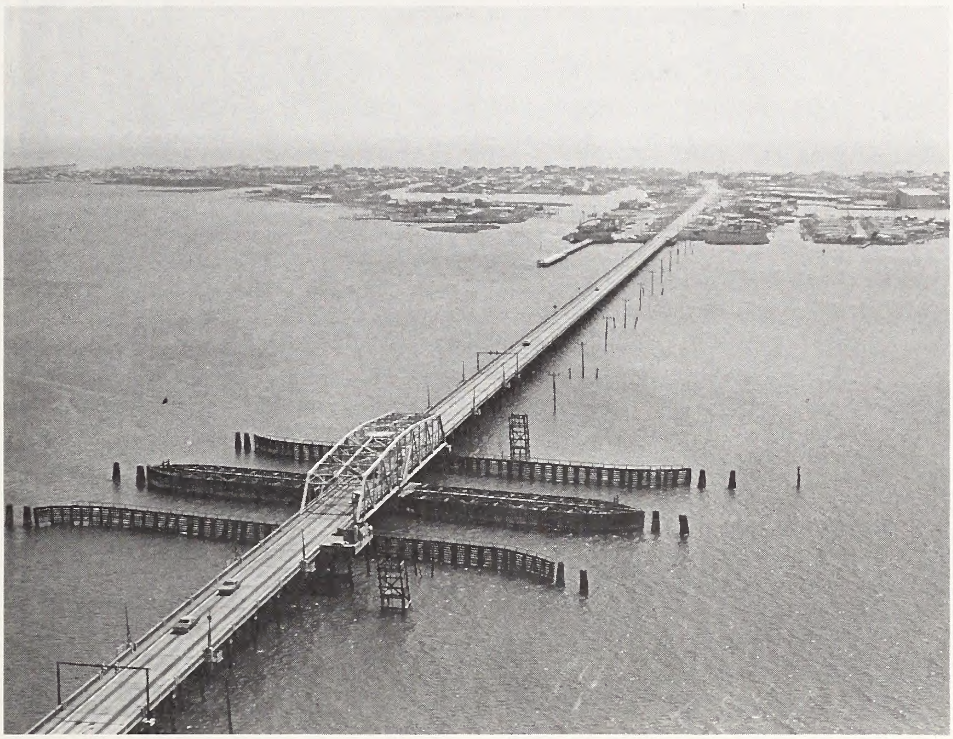
The inlet's channel, once at the northern end of the bridge, has now drifted to the southern end, sweeping about 30 feet of sand from around pilings.

Lee says old pilings had to be stabilized and new ones driven to keep the bridge from collapsing.

Though Lee says the situation is under control now, the Corps of Engineers is considering building jetties to stop the inlet's southerly migration.

This project, however, raises environmental questions that will be considered in the November issue of *Coastwatch*.

Photo by Jim Page



The swing-span bridge that connects Atlantic Beach and Morehead City

Taylors lived high and dry

Andy and Carolyn Taylor are making their home on dry ground these days. But time was when the Pamlico River ran 12 feet beneath the floorboards of their house and U.S. 17 passed within yards of their front door.

The Taylors lived for 12 years on a drawbridge near Washington, N.C.

They and their son, Drew, moved into the house in 1943 so Andy could assume duties as the bridge's tender.

Taylor remained on call 24 hours a day to open the bridge for water traffic that moved up and down the Pamlico River. "For a while Andy worked 29 days a month," says Carolyn Taylor, "and I would have to bring Charlie the barber out from town to cut his hair."

Taylor says the job was dull because traffic on the river was light. But, occasionally there was a little excitement.

Andy recalls that once Carolyn was on the back porch hanging out clothes as a tugboat was hauling a large barge through the opened bridge.

"The tug captain had approached the opening from the wrong angle," Taylor says, "and the barge was headed straight for the corner of the house. I began hollering at my wife to move and at the captain to control the barge."

Carolyn Taylor says she dropped her laundry, headed around the side of the house and ran into the street.

The captain spotted his mistake and corrected the barge's course. But in doing so he caused his own vessel to rock so violently that the operator's house was partially submerged in the water as the tug rolled from side to side, Taylor recalls.

The Taylors also remember Hurricane Hazel's blow through North Carolina in 1954. Taylor remembers that as the storm approached winds became strong and the house began to sway and groan. "When I saw the water in the kitchen sink being sloshed across the floor I told Carolyn it was time for her and the children to leave," he says.

Taylor said he waited the storm out at a nearby filling station where he could keep an eye on the bridge.

While runaway barges and hurricanes weren't usual experiences, the Taylors found that even their everyday life was altered by living on a bridge.

"I used to grieve that Drew didn't have a yard or a neighborhood," says Carolyn Taylor, "but he had his own little boat that he rowed along the river."

Carolyn Taylor said her husband wasn't the only one who knew how to open the bridge. "One night Andy was ill and I had to climb up to the bridge house and open the bridge myself," she said. "Andy had shown me how to open it, but I was scared to death."

The Taylors tried to make their house as much like other homes as possible by planting shrubs, vines and vegetables in barrels around the house and building flower boxes by the windows.

Living on a bridge with small children posed an added worry for the Taylors. They tacked up chicken wire anywhere they thought the children might fall through and watched them closely when they were outdoors.

The Taylors moved away in 1955 and the bridge house was torn down several years later. But Carolyn Taylor keeps a book of snapshots stashed away in a drawer to remind her family of the bridge home.

Lottie Glover at control panel

Photo by Kathy Hart

Bridge gets tender care

Bridge tender Lottie Glover spots the light of a vessel just as it comes into view, south of the Surf City bridge. She hops from her perch on the elevated chair and moves to the window to watch the boat approach.

At night, it's hard to determine whether or not a boat can slide beneath the bridge's span. But, three short blasts of a horn minutes later remove any doubt and Glover moves to her control panel.

She blasts the bridge horn three times and begins turning the knobs and levers that light the panel in Christmassy reds and greens.

First, Glover turns on the red lights at each end of the bridge and simultaneously a bell begins clanging to warn motorists to stop. She then checks up and down the bridge to make sure no cars are on the bridge before lowering the gates.

"You have to be real careful," Glover says, "because when the lights go on and the bells start ringing some people go crazy trying to see how fast they can get across the bridge."

A clanking thud announces that the wedges balancing the bridge in place have been removed. A whining hum begins as the bridge starts its 90° turn.

Once the bridge stops, a trawler moves through the opening. Lottie takes note of its name and waits for the trawler to clear the bridge before reversing the process that ends with traffic streaming across the bridge.

The whole process takes eight minutes. Lottie logs the amount of time the bridge was opened, the weather conditions, the name and kind of boat, and the number of cars stopped for the opening.

"There is a lot more to bridge tending that most people think," Glover says. "You have a lot of lives in your hands when you control both water and road traffic."

Glover, a resident of Surf City, has been tending the bridge for two years. She is the only woman employed by the state as a full-time bridge tender.

The boat captains Glover talks to over the bridge's two-way radio are usually surprised to find a woman operating the bridge, she says.

Glover says she took the job because "it was something different to do." "And," she adds, "I've enjoyed every minute of it."

But Glover has found that there are some drawbacks to the job. "I've been cursed at, honked at and hassled over the telephone by drivers who thought I held the bridge open too long, but I pay it no mind," she says with a grin.

Glover isn't the only bridge tender who has to listen to motorists' complaints, says Jimmy Lee, head of the N.C. Department of Transportation's bridge maintenance unit.

What most motorists don't realize is that in all but emergency cases, water traffic has the right-of-way over road traffic, according to the Coast Guard's regulations for navigable waters.

"It is much easier to stop a car than it is to stop a tug pulling a string of barges," Lee says.

The only exception to the water right-of-way is the heavily-traveled drawbridge at Atlantic Beach. Tenders there open the bridge on demand for commercial vessels and boats in distress. They also open the bridge on demand for recreational vessels, except on summer days between 8 a.m. and 8 p.m., when the bridge opens hourly.

Motorists aren't the only ones who cause problems. Lee says some openings of drawbridges are unnecessary.

Occasionally boat captains blow for the bridge to be opened without first lowering apparatus not essential to navigation, such as fishing outrigging and radio antennas, that would have allowed the boat to pass beneath the unopened bridge, he says.

If this happens, the bridge tender reports the boat's name and number to the nearest Coast Guard commander.

October is the busiest month for the bridge tenders along the intercoastal waterway. "It seems like I'm opening the bridge every five or ten minutes when the yachts and sailboats start to move south to Florida," Glover says.

But things quiet down in winter, when water traffic is minimal. It's just as well, though, because when the winter storms blow in, with gusts over 30 mph, there are times when the bridge can't be opened, Glover says.

Glover does more than just open the bridge. Once a month she counts all the cars that cross the bridge and she is also responsible on her eight-hour shift for keeping the bridge house clean and for greasing the gears that turn the bridge. "I'm a grease monkey sometimes, too," she says.

Glover, who claims to be just "a plain ol' Tar Heel," says she plans to be a bridge tender as long as she can. "They're going to have a hard time getting rid of me," she says.

North Carolina operates "little navy"

Chances are, few inland North Carolinians realize that the state has its own fleet—a fleet of ferries, that is. Folks at places such as Hatteras and Ocracoke, however, know that the ferries are a vital link in North Carolina's coastal transportation.

Currently, there are 15 ferry boats in North Carolina's "little navy," says Ben L. O'Neal, director of the N. C. Department of Transportation's ferry division.

O'Neal says the number of ferries has grown steadily since the division was established in the early 1940s with ferry service across the Alligator River. Now the ferries travel seven routes across sounds, inlets and rivers along the coast.

Many of the early ferry crossings at places like Oregon Inlet and Croatan Sound were stopped after bridges were erected, O'Neal explains. "But when we do away with service in one area we just start it up somewhere else," he says.

Most bridges are, in the long run, less costly than ferries, which require a constant expenditure of funds for upkeep and personnel, state transportation officials say. But the North Carolina coast, with its system of barrier islands, large sounds, shifting inlets and many rivers, often makes ferry service more feasible than bridges, officials say.

Officials also say, traffic to some coastal areas does not warrant the expenditure necessary to build a bridge.

Tolls are charged for the three longest ferry crossings—Ocracoke-Swan Quarter, Cedar Island-Ocracoke and Southport-Ft. Fisher. By charging a fare, the division tries to recoup at least part of its operating cost, O'Neal says. In 1978, $5 million were spent on maintenance and operation of the ferry division, he says.

Fare information and ferry schedules are listed on the official North Carolina highway map distributed by the transportation department and the travel and tourism section of the N.C. Department of Commerce. Ferry information can also be obtained by writing the Ferry Division, N.C. Dept. of Transportation, P.O. Drawer P, Morehead City, N.C. 28557, or by calling (919) 726-6446.

O'Neal emphasizes that people taking the Ocracoke-Swan Quarter ferry or the Cedar Island-Ocracoke ferry should make reservations several days in advance. These ferries are often crowded because they are the main access routes to and from Ocracoke Island and the Outer Banks and reservations are needed to assure people of space on the ferry, O'Neal says.

These reservations may be made in person at the ferry terminal or by telephone between the hours of 6 a.m. and 6 p.m. For departures from Ocracoke, call (919) 928-3841; from Cedar Island, call (919) 225-3551; from Swan Quarter call (919) 926-1111.

Most of the ferry schedules change in the summer months to accommodate the increased traffic from tourists, so travelers should check to see when winter and summer schedules are in effect for each ferry.

The ferries are captained for the most part, O'Neal says, by retired Navy and Coast Guard personnel who have been licensed by the Coast Guard as captains. The Coast Guard also inspects the ferries regularly.

O'Neal says the ferry division is a part of the state's civil preparedness plan to evacuate people in case of a hurricane. He adds that, in the case of a hurricane, ferries would run until conditions became too severe to safely carry passengers. Then they would be moored at various points up and down the coast.

O'Neal says he thinks the ferry system will be around for years to come "because of the traveling needs of the public and the nature of our outer islands."

Photo by N. C. Dept. of Transportation

Bearing passengers from Hatteras, the Ocracoke slides into the dock at Ocracoke Island

Gallop is master Aboard ferry

Captain Derwood E. Gallop stands on the wooden bridge, smiling and speaking to his prospective passengers as they board the ferry for Swan Quarter. But Capt. Gallop is doing more than just getting acquainted; he's checking for leaky gas tanks in the cars and boats being hauled aboard.

"As captain I always want to know what I have on my vessel before we leave the dock," said Gallop. "If I can smell gas leaking I don't allow them aboard because leaking gas could mean a dangerous fire at sea," he said.

Gallop is the captain of the Edmund Hyde, the newest and most plush ship in the state's navy.

Once the boat is loaded, Gallop heads for the bridge to launch the ferry toward Swan Quarter. As soon as the Hyde is safely out of the dock at Ocracoke Island, Gallop picks up the microphone to broadcast the rules for the trip.

"These rules are for the safety of the passengers and so a few don't infringe upon the rights of others," Gallop says.

After the rules are out of the way, Gallop settles back to tell passengers a little history of Ocracoke Island. Gallop started giving these informative lessons a short time ago after combing books for some of the area's more colorful history.

He has since recorded several tape cassettes for other captains to use on the Cedar Island-Ocracoke and Swan Quarter-Ocracoke ferry routes.

After the history lesson is finished, Gallop usually leaves the navigation of the ferry to his quartermaster and heads for the lower deck to chat and mingle with the passengers. He is an obvious hit with them.

"I always enjoy the complimentary letters I receive from the people who ride the ferries," he says. "My basic philosophy is I try to treat people like I would like them to treat me."

But being a ferry captain isn't always easy, says George Godley, Jr., captain of the Silver Lake, one of Cedar Island-Ocracoke ferries. "Once in a while, people get upset and mad at you because of loading procedures," he says. "They see you put somebody on the boat that arrived after they did and they think they're getting cheated. They don't understand that the ferry has to be loaded in a certain way for safety reasons."

Captain Derwood Gallop

Photo by Dennis Rogers

Godley says large vehicles, such as buses and cars pulling campers, are loaded next to the operator's house, while smaller vehicles are loaded next to the railing. This method of loading prevents the ferry from rocking and the larger vehicles from turning over in rough waters, he says.

"It's a balancing act," Godley says, "and each load is different."

Captains also receive complaints when they decide to cancel a crossing because of bad weather, Godley says. "Anytime you are responsible for that many people, no captain is going to jeopardize his license or his passengers' safety by making a crossing in hazardous weather," he says.

Gallop agrees, but adds that cancellations for weather conditions are rare. "Usually only high winds of 40 to 50 knots will stop us from crossing," he says.

Both captains say summer months when lots of tourists are traveling are the busiest months for the ferry service.

"During the summer, you squeeze every car you can on board and still you leave some cars behind to wait for the next ferry," says one crew member.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings and workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

Paul Hosier, a Sea Grant researcher, has been studying the effects of off-road vehicles (ORVs) on beaches, dunes and grasslands. This fall, the National Park Service contracted with Hosier to map ORV damage to the Cape Lookout National Seashore. Hosier has been conducting a similar study at Cape Hatteras.

At Cape Lookout, Hosier will mark off and protect small sections of shoreline, leaving others open to driving, so that he can measure changes in the plant cover. In some of the tests, Hosier will use three-wheeled "all-terrain" vehicles to test whether they cause more or less damage than conventional vehicles. Hosier has also agreed to compose an atlas of the park, showing areas expecially vulnerable to ORVs, and areas more able to tolerate traffic.

Hosier is working with Tom Wolcott, a North Carolina State University zoologist, who is studying the impact of ORVs on the ghost crab population at the shoreline.

As miles and miles of the nation's oceanfront property are parceled out and developed, legions of "no trespassing" signs are springing up to block the public from the shorelines.

The problem of beach access has suddenly become a sore subject among tourists, fishermen and coastal landowners, and a hot potato for government officials.

Back in 1974, David Brower saw the problem coming. With a grant from Sea Grant, Brower investigated the range of laws and policies that applied, and became one of a handful of authorities on beach access.

So when a U.S. House subcommittee on oceanography met in October to conduct hearings on the coming reauthorization of the Coastal Zone Management program, the representatives asked Brower to testify. Brower told the subcommittee that the program should be strengthened to ensure that all citizens can reach the nation's shorelines, especially those areas valued for recreation.

The response, Brower reports, was "surprisingly favorable." In fact, the representatives have asked him to help them draw up specific proposals that would put teeth in the law and keep paths to the beaches open.

The cost of such legislation? As Brower told the subcommittee: "This need not be an expensive program . . . A ten-foot walkway, linked to a remote parking area or bicycle path, could cost very little, but open miles of public beach for use by the public.

For most of us, the Lock Ness monster is little more than an unfocused image from magazines. But to Tim Dinsdale, Nessie is a career. Dinsdale, a native of Wales, gave up engineering to spend 15 years studying the Scottish lock, which he claims does indeed harbor much more than murky water.

During the Sea Grant-sponsored visit Nov. 12 to the North Carolina State University campus in Raleigh, Dinsdale told his audience that the famous lock was once a part of the Atlantic Ocean. During the last ice age, he said, rising land severed the waters from the sea and locked in Nessie's dinosaur-like ancestors.

Showing his well-publicized film of what he claims is Nessie's hump submerging, Dinsdale reviewed the legends and research that have captivated Nessie's fans. The record of monster sitings, photographs and sonic "pictures," he says, proves that Nessie exists.

The "evidence" is still sketchy. But Dinsdale believes. And he has proven at least one thing: There are still occasions when the worlds of science and fancy rub elbows.

People and dogs aren't the only ones that get lazy during hot weather. Sea Grant researcher Mark Sobsey says oysters do, too. Sobsey has been relaying oysters from polluted waters to clean waters to see how fast they can flush viral contaminants from their bodies. He has found that during winter and spring months the oysters cleanse themselves at faster rates as the water becomes warmer.

Sobsey predicted the cleaning rate would reach its peak during summer, but things turned out differently. When water temperatures were 77°F to 80°F, the oysters eliminated only 78 percent of the viruses from their bodies during a thirty-day period. In March and April experiments, the oysters eliminated 99.9 percent of the contaminants in three days.

Sobsey says there could be several possible explanations for the lack of elimination of viruses during hot weather. The warmer water could cause the oysters to become extremely sluggish and therefore reduce the rate at which they flush water through their bodies. Or the viruses could become sequestered in the shellfish tissue because of changes in the shellfish physiology during spawning. Whatever the reason, Sobsey says more experiments are needed to decide why the self-cleaning oyster doesn't tidy up as fast during hot weather.

Continued on next page

Another North Carolina lighthouse is being imperiled by a shifting shoreline. The Cape Hatteras lighthouse, the tallest in the nation, has signaled navigators away from treacherous waters since 1870, when it replaced an older structure built in 1803.

But, because of erosion, authorities believe the lighthouse will collapse—some say within 30 years, others much sooner.

The National Park Service is trying to decide whether to preserve the landmark, either by moving it or arming its foundations against encroaching waters. The park service has enlisted the help of the MTMA Design Group of Raleigh, which is investigating ways to save the building. The design group has asked Jerry Machemehl, an engineer and Sea Grant researcher, to produce plans for protecting the lighthouse.

Machemehl has studied the waves, currents and storm surges of the shoreline, which he terms a "high-energy" area. The problem, he says, is to formulate a design flexible enough to allow the natural shoreline processes to continue, but solid enough to keep the lighthouse erect. One of Machemehl's designs calls for the construction of a revetment that would encircle the lighthouse and, as the shoreline recedes, create a man-made island under the landmark.

Two alternative plans call for groins, beach nourishment and a smaller revetment—all designed to build a buffer of sand between the ocean and the lighthouse.

Machemehl will submit his plans to the park service in January.

The North Carolina Sea Grant program has received funding for its 1980 budget allocations. Sea Grant will receive $1,045,000 in federal funds and $522,500 in state funds. Director B.J. Copeland says this is a 10 percent increase over the 1979 funding. Nine new research projects will be initiated, while 21 others will be continued.

It was an unfamiliar habitat, but 300 coho salmon and 150 rainbow trout weathered eastern North Carolina's hot summer this year. The fish lived in cages in the canals of Texasgulf Inc. on the shores of the Pamlico River near Aurora.

Sea Grant researchers imported the fish last April for one of a series of aquaculture experiments being conducted at the site of NCSU's eel farm, which is headed by Sea Grant associate director Bill Rickards. The eel farm is located on property leased by Texasgulf to East Carolina University.

The water running in the Texasgulf canals comes from underground wells in the plant's open pit mines. Naturally, it is colder than nearby surface waters. In the summertime, the canal water reaches the high 60s, the upper limit of the temperature range tolerated by coho salmon and rainbow trout.

Researchers found that the fish not only survived the summer, they thrived. Both species grew at a faster rate than they would have in the wild. The trout gained weight at a surprising rate, reaching an average size of one-third pound after six months. Growth of the salmon was less impressive, but still enough to encourage researchers about the possibility of raising more salmon in eastern North Carolina.

The experiment ended this fall, when most of the fish died from embolisms caused by gas bubbles. The disease was due to mechanical problems with water dispersion in the canals. Rickards thinks that this problem can be corrected when further experiments are conducted with another group of fish next year.

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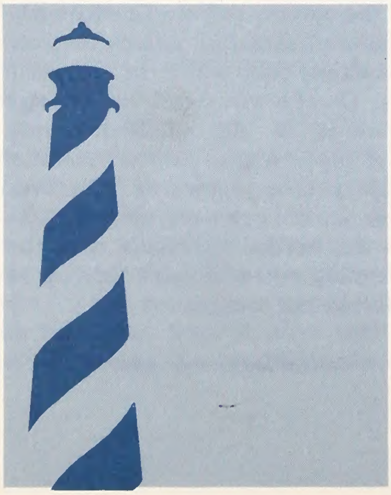

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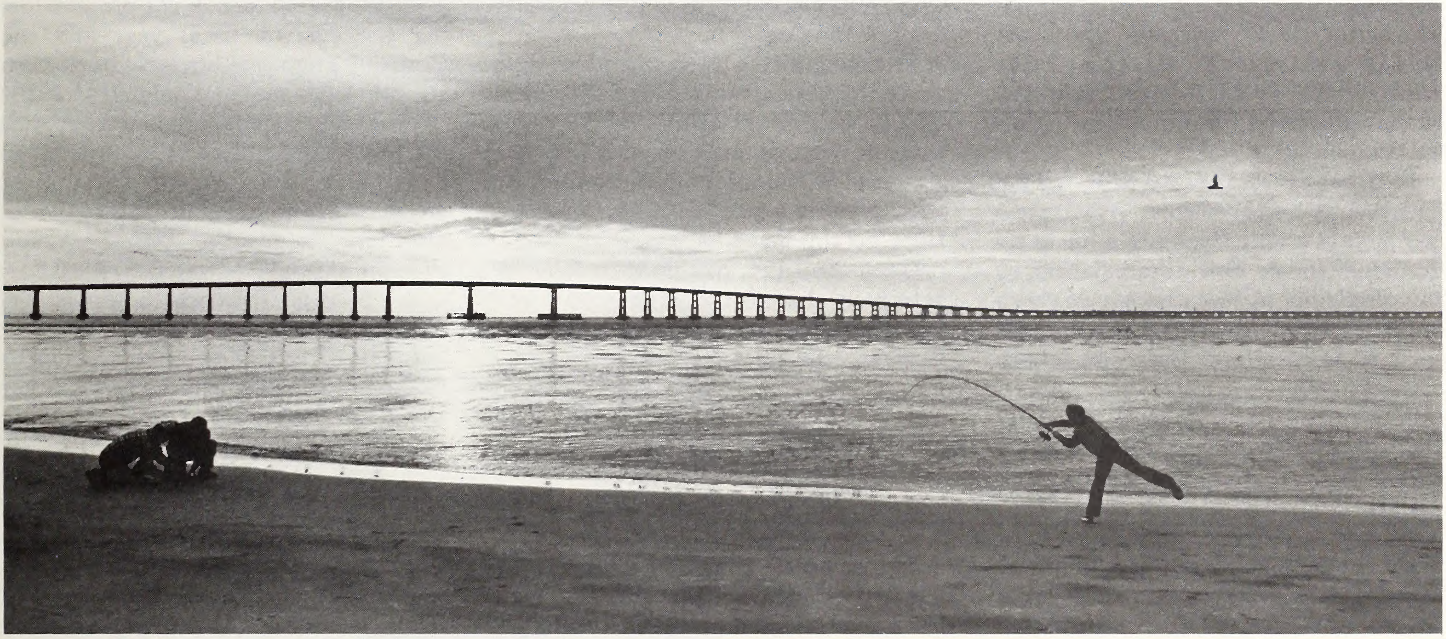

The serenity of Oregon Inlet at sunset belies its changing and sometimes treacherous waters

Which course should inlets take: nature's or man's?

Editor's Note: Providing adequate transportation for coastal North Carolina is no simple matter. The area is laced with numerous rivers and vast sounds, which both aid and hinder transportation. In the first of a two-part series, the October issue of ***Coastwatch*** *examined coastal bridges and ferries. In this issue,* ***Coastwatch*** *takes a look at the waterways themselves and how they are used by both commercial and recreational traffic.*

Ever since he took up commercial fishing twenty years ago, Kenny Daniels has had a running battle with Oregon Inlet.

Sometimes the inlet wins. Ten years ago, for instance, Daniels left his hometown of Wanchese and moved to Virginia when it became impossible to safely navigate the shallow inlet with his trawler.

But family roots run deep in Wanchese and Daniels eventually returned to run the family-owned Wanchese Fish Company. First he sold his old boat. Now the company's ten fishing vessels are built with a shallow draft to allow them to navigate Oregon Inlet. But Daniels contends that this design makes them less seaworthy.

Like a lot of fishermen in the Dare County area, Daniels worries about the safety of his crew. He believes the time has come to stabilize Oregon Inlet.

Not everyone agrees. The question of what to do about many of North Carolina's inlets is developing into a hot issue. Some favor maintaining sufficient channel depth through dredging, while others contend that permanent stabilization with jetties is the only solution. Still others lobby for a policy of leaving inlets undisturbed so that they can follow their natural courses.

North Carolina's 26 inlets flow between the state's outer chain of barrier islands—parcels of land that are constantly moving as the ocean washes the sand away from one place and deposits it somewhere else.

These natural changes often make navigation of the inlets difficult for boat captains and fishermen, who com-

Continued on next page

plain of the hazards. Daniels is one.

"Most of the boats that get in trouble in the inlet are people not familiar with the area," Daniels says. Coast Guard Quartermaster Dennis Purcell agrees. Purcell, stationed at the Cape Hatteras Coast Guard station, says many out-of-state boats ask to follow Coast Guard escorts or local fishermen through the inlet.

Situated near what scientists call "high energy" beaches, Oregon Inlet frequently shoals with sand and its channel migrates southward. Four fishermen lost their lives in the inlet last April after their boat became disabled and was smashed against the inlet's ocean bar, Purcell says. The Coast Guard station at Oregon Inlet answered 320 calls last year; 180 to 190 of the calls came from boats in the inlet, Purcell adds.

In recent years, state and federal agencies have answered fishermen's complaints about the state's inlets by dredging them. But some fishermen say dredging is not enough to keep some of the more widely-used inlets, such as Oregon and Ocracoke Inlets, deep enough to accommodate many commercial fishing boats.

"You're risking a half-million-dollar boat and sometimes life, too . . ."—Roger Jones

Fishermen are asking the state and federal government to stabilize some of these inlets with jetties, which would fix the horizontal position of the inlets, reduce the amount of sand deposited in channels and decrease turbulence. Many inlets along the Atlantic and Gulf coasts have already been stabilized. It's not a new idea. Fishermen in Dare County have been clamoring for stabilization of Oregon Inlet since the 1950s.

"It's a big thing, a major undertaking, to try to stabilize inlets along this treacherous coast, but it can be done if we the people push hard enough," says Roger Jones, owner of R. W. Jones Fish Co. in Carteret County.

Masonboro Inlet is partially stabilized with jetties now and plans are in the works for jetties at Little River and Oregon Inlet.

The U.S. Army Corps of Engineers maintains the inlets. But N.C. Secretary of Natural Resources and Community Development Howard Lee has decided that the state should take a role in establishing priorities for inlet maintenance. Last year Lee appointed a committee of coastal specialists and fishermen to study the state's inlets.

"The corps has begun to look more to the state for guidance on these projects and it may begin to look to us for funding in the future, too. So it was decided we should begin to take a greater leadership role in establishing which ones are essential to the state," says Ronald Earl Mason, chairman of the committee.

The committee presented its recommendations to Lee in October, but Mason and engineers for the corps emphasize that these recommendations are not binding.

The committee recommended that those inlets programmed for stabilization be completed as soon as possible, that the deep water inlets at Morehead City and Wilmington be maintained at their present depth and that Ocracoke Inlet be stabilized.

Ocracoke Inlet, like Oregon Inlet, is extremely changeable. Jones says fewer and fewer fishermen are trying to navigate the inlet and the dangerous inside channel, Big Foot Slough. Instead, he says, fishermen are using Beaufort Inlet and occasionally Oregon Inlet to bring in their catches.

"You're risking a half-million-dollar boat and sometimes life, too," Jones says. "It's just not worth it."

A jetty was authorized for the north side of Ocracoke Inlet in 1960, but the Corps of Engineers deferred construction. "We have not determined there is need for a jetty at Ocracoke yet," says Tom Swain, the Corps of Engineers chief of navigation reports at the Wilmington district office. "We have the inlet under control."

Swain contends that the inlet is deep enough, but that its channel needs to be more closely monitored and marked for changes by the U.S. Coast Guard.

"The real problem at Ocracoke comes just inside the inlet in the sound at Big Foot Slough," Swain says.

Swain says the Corps of Engineers plans to build sandbar dikes at the Slough and dredge the channel to a 15-foot depth. He emphasizes that there are no plans for jetties.

However, Lee said recently that the state may be willing to foot some of the bill for stabilization of Ocracoke Inlet. But corps engineers say unless the project is begun soon the costs will outweigh the benefits.

One corps engineer speculates that, considering the rising cost of such projects, Oregon Inlet will be the last inlet ever stabilized along the east coast.

When authorized in 1970, the Oregon Inlet stabilization was approved at an estimated $9 million. Now after numerous delays, the corps estimates that stabilization will cost $61 million with an annual upkeep cost of about $2 million. Congress has set aside funds for starting the project during the current fiscal year and the Corps of Engineers hopes to begin construction during the summer of 1980.

In spite of Congressional approval, the project still doesn't have the green light. The Corps of Engineers must answer some important environmental questions before the U.S. Fish and Wildlife Service and the U.S. Park Service will grant the corps land-use permits needed to begin construction.

Larry Roush, chief of resource management and visitors protection at the Park Service's Cape Hatteras National Seashore, says the park service is concerned that the project will accelerate erosion of its land on Bodie Island. Officials of the U.S. Fish and Wildlife Service are worried about erosion on the wildlife refuge at Pea Island.

The proposed jetties, which will extend 1½ miles into the ocean, will stop much of the sand that moves up and down the beach. This will deprive these beaches of sand which normally replaces sand lost to the continental shelf and other beaches.

The Corps of Engineers plans to alleviate this problem with a sand bypassing system that will employ a pipeline dredge to transport sand from the north side of the jetties to the areas of sand depletion.

Lawrence Saunders, chief of economic analysis for the Wilmington district of the Corps of Engineers, says the corps expects to operate the dredge once a year and bypass 400,000 to 500,000 cubic yards of sand.

The final design plans for the sand-bypassing system are not on paper yet, though the system is "conceptually feasible" Saunders says. The parks service wants to see final plans, however, before any decision is made.

But East Carolina University

Photo by J. Foster Scott

Photo by Gene Furr

WANCHESE HARBOR DEVELOPMENT
CONTRACTORS: H.G. HARDERS & SON
ENGINEERS: J.E. SIRRINE CO. CENTURY SOUTHERN Inc
STATE OF NORTH CAROLINA–DARE COUNTY PROJECT
SUPPORTED BY
ECONOMIC DEVELOPMENT ADMINISTRATION
COASTAL PLAINS REGIONAL COMMISSION
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The Wanchese Harbor of old (above) is a sharp contrast to the plans (left) state and local officials have for harbor development and construction of a seafood industrial park.

The eventual success of the state's seafood industrial park is partially dependent upon stabilization. Only if the inlet is stabilized will the park be able to attract enough large trawlers for full operation. In fact, says Lawrence Saunders of the Corps of Engineers, the park will reach only 25 to 35 percent of its potential if the jetties are not built.

That may mean a lot of the taxpayers' money down the drain. Authorized in 1970, the Wanchese Seafood Industrial Park is being jointly funded by local, state and federal government. When completed in early 1981, it will carry a price tag of about $7.2 million. The park is designed to boost the seafood industry by encouraging more seafood processing in the state. When complete, it will have a 15-acre, deep-water harbor adjoining 36 acres to be leased to private industries for the construction of processing facilities and auxiliary businesses.

geologist Stan Riggs says that may not be enough. "The beaches need sediment and sand during high energy storms like northeasters that occur during the winter, but the corps is proposing to bypass the sand only during the summer," he says. "This may not necessarily be when the beach needs it."

Saunders says the bypass system can be flexible and the Corps of Engineers will constantly monitor the beaches to determine when bypassing is needed. The system is designed to bypass up to a million cubic yards of sediment a year if necessary, he says.

But Riggs is not convinced that the Corps of Engineers understands the "processes of such a highly dynamic system at Oregon Inlet well enough" to adequately predict the consequences of stabilization.

"The Oregon Inlet bridge is a perfect example," Riggs says. "The state is having problems there now because they didn't understand the dynamics of the inlet when the bridge was built."

Riggs says that building jetties at Oregon Inlet will only increase the possibility of a new inlet blowing through another narrow, low-lying area along the barrier islands.

"An inlet is like a self-adjusting valve that allows water in and out of the sound as the pressure builds and lessens. When you put in jetties you tend to lock the inlet in and doing this only increases the pressure somewhere else," he says.

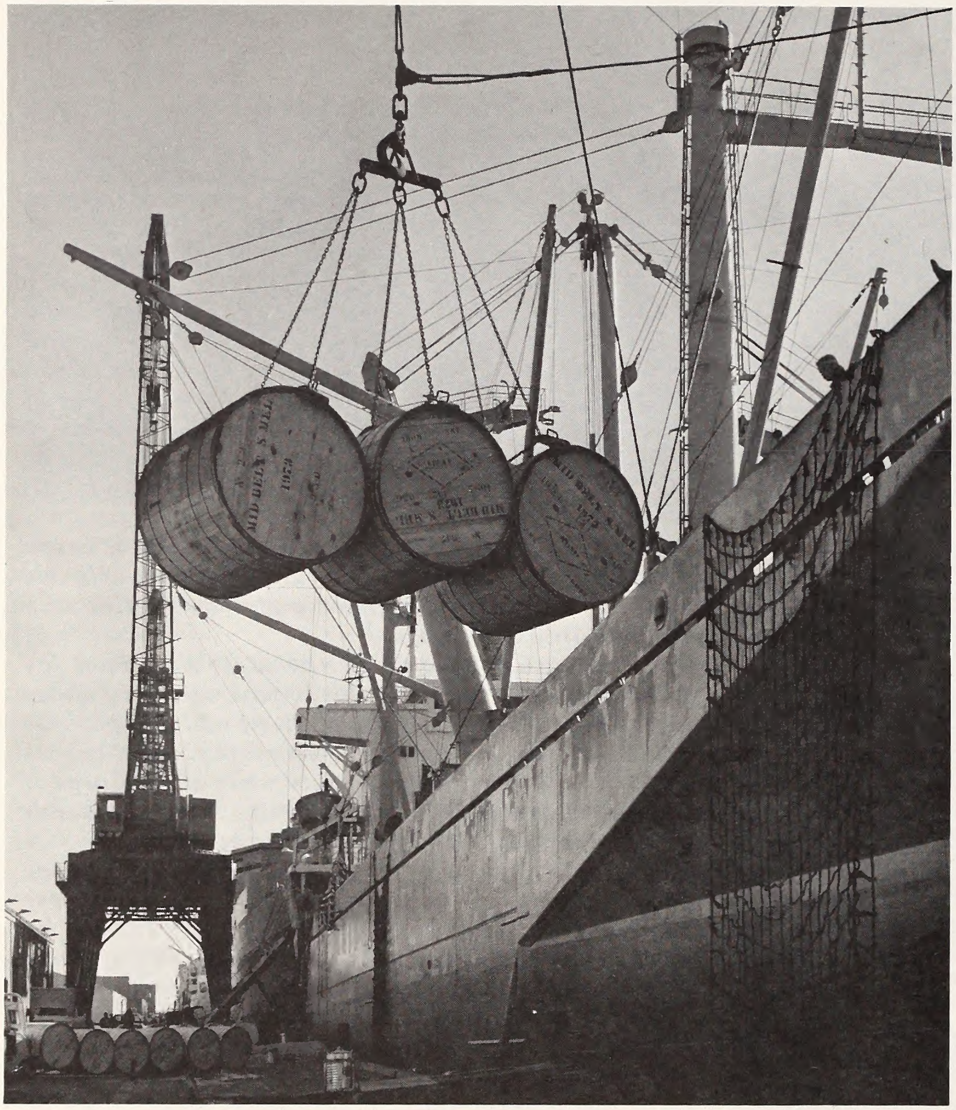
Saunders says Riggs' predictions are unfounded. The amount of water exchanged between the ocean and the sound will remain the same after stabilization occurs in the inlet. And, he adds, salinity levels, vital to fish and shellfish survival, should go unchanged.

However, officials of the Park Service and the Fish and Wildlife Service remain doubtful. "We feel we have some legitimate concerns," says David Rackley of the Fish and Wildlife Service. "We would like nothing better than to tell the Corps of Engineers to go ahead and make the inlet safe, but we can't do that at the expense of the fisheries and our refuge."

Rackley says that, ultimately, the Fish and Wildlife Service can appeal to the federal Council on Environmental Quality "to can the project" if it is not satisfied with the corps' plans.

This will be a last resort, Rackley says. The Corps of Engineers and the two federal agencies are looking for answers that will satisfy everyone.

Photo by Clay Nolen



Hogsheads of tobacco are loaded onto a ship at Morehead City

State ports inching into the black

It took a controversy over a $2.5 million 40-ton container crane to get the North Carolina ports in the headlines. That's the most North Carolinians had heard about their state ports at Wilmington and Morehead City, which have in the past been among the least-used ports on the eastern seaboard.

But that picture could be changing. Wilmington and Morehead City soon may be as high on the lists of importers and exporters as the port cities of Charleston, Norfolk and Savannah are now. According to North Carolina State Ports Authority (SPA) officials, Morehead City and Wilmington are fast becoming major ports along the east coast.

In the 1978-79 fiscal year, the two ports showed the largest profit in the 27-year operation of the ports authority, says Bill Stover, the SPA director of communication. Total net profit was $563,214, up from a $152,000 deficit last year and a 220 percent increase over the previous best year.

The Wilmington profits for 1978-79 were $776,272, while Morehead City again recorded a deficit of $202,295. The deficit was reduced two-thirds from the previous year, and SPA officials believe this year that port will break even. Officials also note that the ports are no longer requiring a $150,000 supplement from the General Assembly to operate.

But Gov. James B. Hunt Jr. said at a July SPA meeting that if the ports are to continue to grow they must receive better support from industry within the state. "Statewide, we are developing special marketing efforts to convince more of our industries that are now shipping out of our state to ship through the ports within this state," he said.

A poor east-west highway system in the state has hurt port development, Stover says. "Many Piedmont industries have found it quicker and sometimes cheaper to transport goods to Norfolk, Charleston or Savannah because they have four-lane highways to these areas," he says. "There are no four-lane highways from the Piedmont to Wilmington and Morehead City."

The answer to the transportation problem may be an inland port. A consulting firm, hired by the SPA, has suggested that the inland port facility, located in the Piedmont, could act as a collecting point for containers that would later be shipped by rail to Wilmington.

The firm found that North Carolina produced more goods for the international market than any of its surrounding neighbors, yet only 30 percent of these goods were being exported via the North Carolina ports. With the inland port, the firm estimates that North Carolina could have 70 percent of all the container shipping traffic in the state. Stover says, however, that the inland port is merely a suggestion and will have to be carefully considered.

In the past, a paucity of major shipping lines calling at the ports also slowed development, Stover says. There are now ten regular shipping lines calling at the Wilmington port, compared to three lines two years ago. Five shipping lines call at Morehead City, where none called two years ago.

The shipping lines that call on the state's ports serve all major world ports except Australia, Puerto Rico and South America. But, Stover adds, lines that serve these areas will call on the North Carolina ports when there is a large shipment.

"We see the next five years as growth years and our theme is 'The New North Carolina Ports,' " Stover says. "We're not the ports we used to be. We're growing, competitive and aggressive ports with more services to offer our customers."

"Norfolk and Charleston are no longer going to get the slack we can't handle because now we can handle it," said Hunt in July. "Those businesses that haven't checked out the Wilmington and Morehead City ports in the past two years should. They'll find new and improved services, expanded facilities and a strong desire to be the best-run ports on the east coast."

This year the Wilmington port added 26 acres of paved open storage to its facilities at a cost of $1,135,000, while at Morehead City $447,000 in capital improvements were made. The General Assembly allotted $7.5 million, the largest state appropriation ever, to the SPA this year to operate the ports.

Stover says SPA plans are to develop Wilmington into the state's container port. This year 23,000 to 24,000 containers crossed the docks at Wilmington, and by 1985 the SPA expects 200,000 containers to be moved. This will call for an additional three to four container cranes.

Morehead City, on the other hand, is seen more as a bulk port, exporting goods like tobacco and lumber. It is the largest tobacco exporting port on the east coast, Stover says. But, he adds, this has made the port's revenues dependent on a fluctuating tobacco harvest.

The Morehead City port is now becoming one of the east coast's leading exporters of lumber, and this, the SPA hopes, will provide the port a more steady income.

Stover says another container crane also may be in the Morehead City port's future if the port can attract enough container business. Lack of container business was the reason behind the SPA's decision to move the port's first container crane to Wilmington.

The move spurred a major controversy and added to the long-time rivalry between the two ports. Some Morehead City residents say the SPA's decision was yet another example of the state's favoritism toward Wilmington.

But others say it was the state's desire to treat the ports equally that initially led to the problem. When Wilmington needed a container crane in the mid 1970s, one was also placed at Morehead City. However, the Morehead City port had not developed any container business and the crane sat idle most of its 18 month stay, incurring heavy costs which kept the port running at a deficit, Stover says.

In November 1978, the SPA voted to move the crane to Wilmington. Some Morehead City residents banded together to stop the crane's removal, taking their fight first to the N.C. General Assembly and later to the courts.

Their efforts failed. In June, 1979, the crane was moved to Wilmington. Defending the SPA decision, Stover says the crane was used more in its first two months at Wilmington that it was ever used at Morehead City.

"The Morehead faction is insisting that there will be enough business to warrant a crane at the port next year," he says. "But that does not match our figures. Another crane will be put at Morehead City as soon as it becomes detrimental to the port not to have one."

Meanwhile, SPA officials are hoping the effort to develop the two ports along different lines may still some of the rivalry and put them on the road to becoming major eastern ports.

Intracoastal waterway provides haven for vessels

The Atlantic Intracoastal Waterway meanders through North Carolina, offering commercial and recreational vessels a protected haven from the unpredictable ocean.

Its path through the state is 308 miles long. Most of it winds just behind North Carolina's barrier islands and through the sounds and rivers, but several sections had to be dug through land masses.

Built in the 1920s and 1930s, the waterway, which extends from Florida to New Jersey, was designed to provide a protected passageway for commerce to move along the east coast.

The waterway was to be the Atlantic seaboard's answer to the Mississippi River. But it has never reached that potential, says Tom Swain, chief of navigation reports for the Wilmington district of the U.S. Army Corps of Engineers.

A lack of industrial development along the southeastern coast has limited waterway use, Swain says. "There are big cities, big industries, and a lot of grain movement along the Mississippi River to boost its traffic," he says.

In 1977, more than 3 million tons of material were transported in North Carolina over the waterway, Swain says. This was more than in South Carolina, Virginia, Georgia or Florida, where there is not as much intra-port transportation, he adds.

Swain says it is more economical to transport bulk loads of heavy materials by water than by truck or railroad. A ton of materials can be moved along the waterway for a cost of 1½ cents a mile, whereas a ton of material moved by rail costs 4½ cents a mile and by truck, 17 cents a mile.

The hitch, Swain adds, is that water transportation is slower. "I wouldn't recommend it for someone who needed to have materials immediately," Swain says.

Don Bennett, traffic and transportation supervisor of distribution for Texasgulf Inc. says, however, that if a company plans to transport enormous quantities of material, the waterway may indeed be faster.

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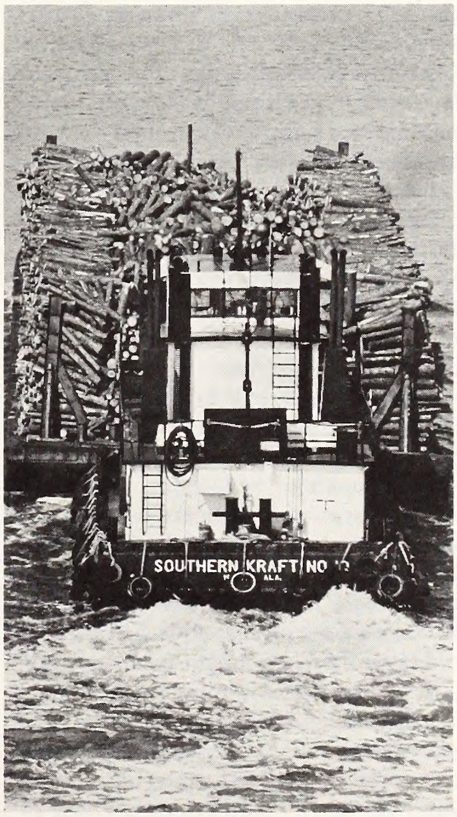
Photo by Steve Murray



Barge moves along the waterway

"A barge can carry 4,000 tons in one trip, while a truck can only carry 25 tons," Bennett says. "Sure the truck might get there faster, but think of how many trips it would take to deliver the same tonnage."

Bennett says Texasgulf has found the waterway to be a cheap and easy means of bringing in large quantities of raw materials and shipping out the company's finished product. Texasgulf has purchased it's own barges and tugboats for transportation of materials, he says.

Commercial use aside, the intracoastal waterway is probably best known as the yachtman's highway. Each year about 2,000 yachts, sailboats and cruisers travel along the waterway in late fall and early spring as boaters move south for the winter and then north for the summer. Recreational and commercial fishermen also use the waterway to move from one fishing ground to another.

To keep the waterway navigable for both commercial and recreational use, the Corps of Engineers must constantly dredge parts of the waterway to maintain its designated 12-foot depth and 90-foot width.

Jim Wells, an engineer for the corps, says two to three million cubic yards of material are removed from the waterway each year. He says the corps' heaviest maintenance job is in Brunswick County, where the waterway is subject to tidal influence. The Corps of Engineers also does a lot of maintenance work on the waterway's land cuts to the Alligator and Pungo Rivers, Wells says.

Officials of some companies using the waterway complain that it is not adequately maintained. Dave Hewitt, the Corps of Engineers' public information officer in Wilmington, acknowledges that there is sometimes a problem with maintenance. "We dredge areas where there is the greatest need first," he says. "But we always have a backlog."

The Corps of Engineers uses survey boats to determine which areas need dredging and to investigate the complaints they receive, Hewitt says. He estimates the corps spends $10 million to $15 million a year on maintenance.

Dredging became a bigger headache for the Corps of Engineers after a 1971 regulation made it illegal for the corps to dispose of dredged material in open water. Now the corps must dispose of dredged material in either diked islands or behind shoreline dikes.

Photo by Clay Nolen

Sailboats like these crowd the waterway each spring and fall

As there is limited island space that can be used for disposal, the corps soon may be trying to dispose of the material along the 100-foot easement deeded to the corps when the waterway was built. This may lead to problems, however, since developers have since sold property within the easement and homes have been built there. The problem is particularly acute in Brunswick County, where about 100 homes, as well as the Holden Beach Town Hall and the Holden Chapel Church, are situated within the easement.

Corps officials have recently notified landowners, developers, bankers and others in the area that the agency has "the perpetual right to use land within the easement and have placed a moratorium on construction in the area," Hewitt says.

The corps is basing its actions on a 1975 court case in Carteret County in which the federal court ruled that further development of property within the easement was not compatible with corps use.

Homeowners living in the easement in Brunswick County are upset by the Corps of Engineers' actions. They fear that the corps might next ask them to tear down their homes or relocate. Brunswick County Attorney John R. Hughes has represented these homeowners in negotiations with the Corps of Engineers. Hughes says county administrators planned to meet with corps and state officials December 18, "to gain assurances in writing for the homeowners that their homes will not be disturbed."

The owners of undeveloped land in the easement will have to negotiate with the corps on an individual basis, Hughes adds. "The situation was potentially devastating if the corps had taken a hard line toward the problem, but fortunately they have not," he says.

The Corps of Engineers is blaming no one for the encroachment on its easement. "It's our belief that development has taken place inadvertently," Hewitt says.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings and workshops, and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

The Rangia clam may no longer be considered a trash food junkie, eating only other sea creatures' cast-offs. Sea Grant researcher Don Jeffreys of East Carolina University has found in laboratory tests that Rangia clams will eat euglena, a form of algae, and live bacteria. Researchers have been unsure of the clam's food sources and believe it to be a "trash eater."

In another part of the study on Rangia clams. Sea Grant researcher Barney Kane of ECU has found that clams taken from the same area may exhibit widely varying bacteria counts. In an experiment with nine clams, eight clams showed a bacteria count of less than 10,000, while one clam had a count of more than 160,000. A high bacteria count means the clam will have a shorter shelf life when marketed. Kane says further studies are needed to determine why bacteria counts vary so widely.

Kane also has found that increased water turbidity due to dredging has only a slight effect on bacteria counts in the clams. Articles in scientific journals had suggested that high bacteria counts resulted during increased turbidity. But Kane said experiments at a dredge site in the Pamlico Sound showed only a slight increase in the clams' bacteria count.

Wanted alive: thousands of elvers from eastern North Carolina's streams, rivers and inlets. Description: baby eels, two-and-a-half to three inches long, nearly transparent. Between January and March, elvers can be seen migrating upstream into brackish and fresh waters. They usually travel in large schools and often can be found near dams and culverts.

If you spot a large school of elvers, please call the North Carolina State University Eel Aquaculture Project in Aurora, (919) 322-4054. Ask for John Foster or Jack McCauley.

Researchers with the Sea Grant-supported eel farm are looking this year for a big crop of elvers to stock their newly-completed, grow-out ponds. Last year the eel farm moved from New Bern to expanded facilities on the shores of the Pamlico River.

Since 1975 researchers have been perfecting techniques for raising eels in eastern North Carolina. Cultured eels are in demand in the Orient and in parts of Europe, where they are considered delicacies.

After Christmas when the Yuletide spirit has fizzled and it's time to take down the decorations, don't throw away your Christmas tree. Old Christmas trees can be used to mend damaged sand dunes, according to Sea Grant coastal engineer Spencer Rogers.

The trees are most useful where pedestrian traffic has worn a sand dune down and killed the vegetation. Rogers says a Christmas tree is very effective for repairing dunes because its thickness slows the velocity of sand-laden winds. The sand then drops out and accumulates around the tree. In windy areas, a tree could trap up to five feet of sand a year.

To mend the dune, Rogers says, line the tree up with the crest line of the adjoining dunes. It should be on its side and parallel to the beach. Be sure to position the tree far enough landward so it won't be affected by the highest tides. If using more than one tree to fill the gap, line them up end to end parallel to the shoreline, Rogers says.

Christmas trees also can be used to encourage emerging dunes. Place the trees in low areas in front of the forming dunes. *The Dune Book* offers further information on stabilizing dunes. For a free copy, write Sea Grant, Box 5001, Raleigh, N.C. 27650.

One of the regular expenses for charter boat operators is bait. Fishermen use a lot of it. Traditionally, the favorite bait for marlin fishing is ballyhoo, which is relatively expensive and must be shipped from Florida.

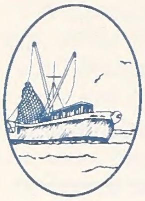
Last spring Sea Grant recreation agent Dennis Regan and Robert (Huck) Harris with the Division of Marine Fisheries got the idea of cutting down on costs by using hickory shad as skip bait. In North Carolina the female shad is caught for roe, but there is no market for the buck shad.

During the short shad run last spring, Regan and Harris caught 300 pounds of shad. They then brined the fish and froze it. Brining, soaking in a high-salt solution, is necessary to keep the fish from falling apart when it's dragged through the water.

Early in the season, Regan and Harris gave the frozen shad to charter boat captains working out of Oregon Inlet. Many of the captains reported that they liked using the shad, which they say has good action in the water. It was a poor marlin season, but at least one 300-pound marlin was caught on hickory shad. The bait apparently works well for dolphin and wahoo also.

Regan and Harris are planning to experiment with hickory shad bait on a larger scale next summer. They hope to distribute the bait to fishermen all along the coast. If all goes well, it could mean extra income for commercial fishermen and a new bait industry for North Carolina.

Continued on next page



Does the prospect of tax time make you flinch? If you're a commercial fisherman or charter boat owner, a series of tax workshops sponsored by Sea Grant and the N.C. Agricultural Extension Service could make things a little easier.

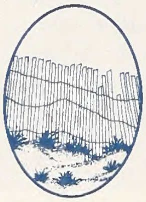
Whether you usually prepare your tax forms yourself or hire a professional, you may not be aware of all the ways you can legally cut down on your taxes. Did you know, for instance, that you might be able to save money if you include on your payroll family members who work for you?

Sea Grant's economist Leon Abbas and agricultural extension economists Jim Easley and Bill Eickhoff are planning three tax workshops for commercial fishermen and charter boat owners to be held during January in Wilmington and at the Marine Resources Centers on Bogue Banks and Roanoke Island. Final dates have not yet been set. For more information, contact the Sea Grant agent in your area: Leon Abbas, Raleigh (919) 737-2454; Jim Bahen, Fort Fisher, (919) 458-5498; Bob Hines, Bogue Banks, (919) 726-0125; and Hughes Tillett, Roanoke Island, (919) 473-3937.

Discussions will cover a variety of topics, including income averaging, tax changes for 1980, the effects on taxes of buying and selling assets, depreciation and investment credit. A representative of the Internal Revenue Service also will be present.

To some folks 4-H means cows, chickens and tobacco. But 4-H is much more than agriculture for the 190,000 young people who are members of 4-H clubs in North Carolina. Through club meetings and special interest groups, many of them learn about everything from bicycling to political science.

Beginning next spring, marine studies will be added to the repertoire of subjects leaders teach at club meetings. Last summer Sea Grant awarded a mini-grant so that Paulette Britt of Raleigh could write several lesson plans to be used in 4-H club sessions. Britt, a former teacher and extension agent, worked with education specialists Lundie Mauldin of Sea Grant and Neal Conoley of the Office of Marine Affairs. Together, they came up with four simple lesson plans designed to increase the club members' understanding of the ecology and economy of the coastal area.



Along the state's sounds and estuaries, erosion is raking away soil and hitting landowners where they live. A study by Sea Grant researchers Ernie Seneca and Steve Broome of North Carolina State University has shown that, in many cases, marsh grasses planted along shorelines can slow or stop erosion. But now that the word is out, there is a problem: How can people find the kind of cordgrass they need for transplants?

Dune grasses have been available from dealers for some time, but Seneca says he's been unable to find anyone interested in supplying landowners with marsh grass. So he has begun to develop nurseries to produce the grasses—one near Lockwood Folly Inlet, one near Beaufort, and one near Sunset Beach. He plans a fourth nursery in the Manteo area next year.

Seneca is training county agricultural extension agents to manage nurseries and provide landowners with the plants and information they need to start their own plantings.

Not all plantings succeed. But Broome says slow-release fertilizers improve the odds for a good stand of grass. In some test sites, he has found shortages of nitrogen and phosphorus, which he says should be added to the furrows when the grasses are planted.

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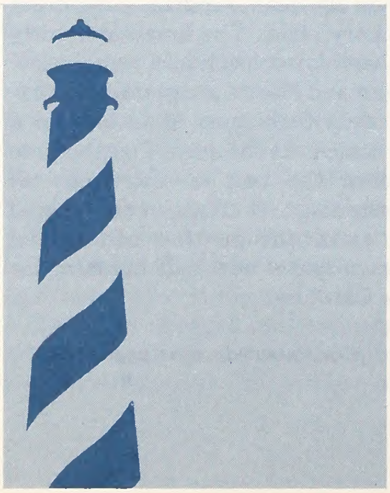

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COASTWATCH

Researchers to study new wrinkles in fabric of coast

Understanding the coast of North Carolina would be difficult enough if things weren't in such a hurry to change. New growth, new technology, expanding fisheries, more people to accomodate—as these pressures on the coast's resources have increased, so have Sea Grant's efforts to answer the questions that keep popping up. Occasionally, the answers are available from other states or regions, places that have already faced some growing spells and puzzled through the problems. But hand-me-down answers are not always tailored to the bent of North Carolina's coastline.

UNC Sea Grant is funding nine new projects this year, six of which are to be conducted by researchers or research teams new to the program. In each of these projects, investigators will be studying problems expected to come into focus during the 1980s—from the displacement of people by machines in the seafood industry, to the disruption of estuarine grass bottoms by clam kicking.

New to North Carolina, "clam kicking," a mechanical method of harvesting clams, is stirring up more than just estuarine and river bottoms these days. It's stirring controversy, too. Some fishermen like the new method because it requires less time to land more clams than previous hand-operated raking methods. But other fishermen, biologists and management officials are concerned that clam kicking, which involves stirring up the bottom with the engine propeller of a boat, may be damaging habitats vital to other fishes and jeopardizing future clam production.

The state Division of Marine Fisheries opened some areas to clam kicking this year, but more information is needed to determine the effects of this harvesting method. Three Sea

Continued on next page

Photo by Steve Murray

Tongs and strong arms, the traditional tools of clamming, are good enough to fill the buckets of Paul Huey, fishing near Harkers Island. But the old methods have begun to give way to mechanical "clam kicking."

Grant researchers, Charles Peterson and Richard Deriso of the University of North Carolina at Chapel Hill (UNC-CH), along with Peter Fricke of East Carolina University (ECU), are beginning a study of hard clams. Applying clam biology and a study of the clams' abundance, the researchers will try to determine how clam kicking affects estuarine bottoms and what effect it might have on future clam colonies. Another aspect of the study will focus on the socio-economic impact of management policies. The researchers will mark young clams, follow their life cycle, conduct clam-kicking experiments and survey clam fishermen. Their study may help officials manage this controversial harvesting method.

Shrimping

After a poor shrimp harvest in 1978, North Carolina shrimp fishermen, processors and marketers suffered economic losses. A relief program was initiated to recoup some of the losses, but only three percent of the state's shrimpers and five percent of the dealers applied for and received loans. Why did so few seek aid? Officials are unsure of the answer because little is known about the social and cultural aspects of the shrimp fishery. That's why sociologists John Maiolo and John Bort of ECU are beginning a study of the fishery. They want to find out how traditions, kinships, experience and education affect the shrimpers' views of the fishery; how the fishing industry perceives federal and state aid programs, and how many members of the fishing industry have alternate income sources. Maiolo and Bort plan to interview fishermen, processors, marketers and fisheries experts.

Water

Water is the lifeblood of every seafood processing plant. You can't steam crabs, fillet fish or shuck scallops without it. In North Carolina, most processors pump water from a nearby stream into the plant. In the past, the used water, including the seafood wastes, often went right back into the stream.

But that's changing. The Environmental Protection Agency now requires that the discharge water be treated. Some seafood processors complain that conventional methods of treatment are complex and expensive. In response, North Carolina State University (NCSU) engineers Allen Chao and Jerry Machemehl, and poultry scientist Jason Shih, are trying to come up with a cheaper, but equally effective, method.

This year the researchers will experiment with a semi-permeable membrane which traps fats and proteins, but allows small molecules, such as those in water, to pass. The researchers believe that the water will be clean enough for reuse in the plant, thereby cutting down on water consumption and energy use. Higher operating costs of the proposed system would be further offset by the fact that the plants might be able to sell the trapped material for use in pet food or other products.

Photo by Karen Jurgensen

Growing more than cypress trees, North Carolina's fertile estuaries are the nurseries for many of the state's fish and shellfish

Jobs

One of the growing pains industries commonly have is the problem of machines displacing people. Often, machines replace unskilled workers and, at the same time, create new, more specialized jobs for people who can look after the machines. The seafood industry is no exception. And, as the industry continues to grow, many see manpower problems on the horizon.

This year, Nozar Hashemzadeh and Michael Simmons, two assistant professors of economics at North Carolina A & T State University, begin a Sea Grant-funded study of the problems. In 1980, the researchers will intern with the N. C. Department of Labor to learn ways to help ease the impact of advancing technology on people and the job market. Working with the Center for Manpower Development at A & T, Hashemzadeh and Simmons will then try to assess the industry's manpower requirements for the future.

Bluefish

The bluefish is no stranger to coastal residents. Each year more than 100 million pounds of bluefish are caught by sport and commercial fishermen in the United States.

But, like many ocean migrating fish, the bluefish has scientists baffled. Because the bluefish is hard to track, fisheries experts are unsure about the number of species or subspecies which live along the Atlantic coast.

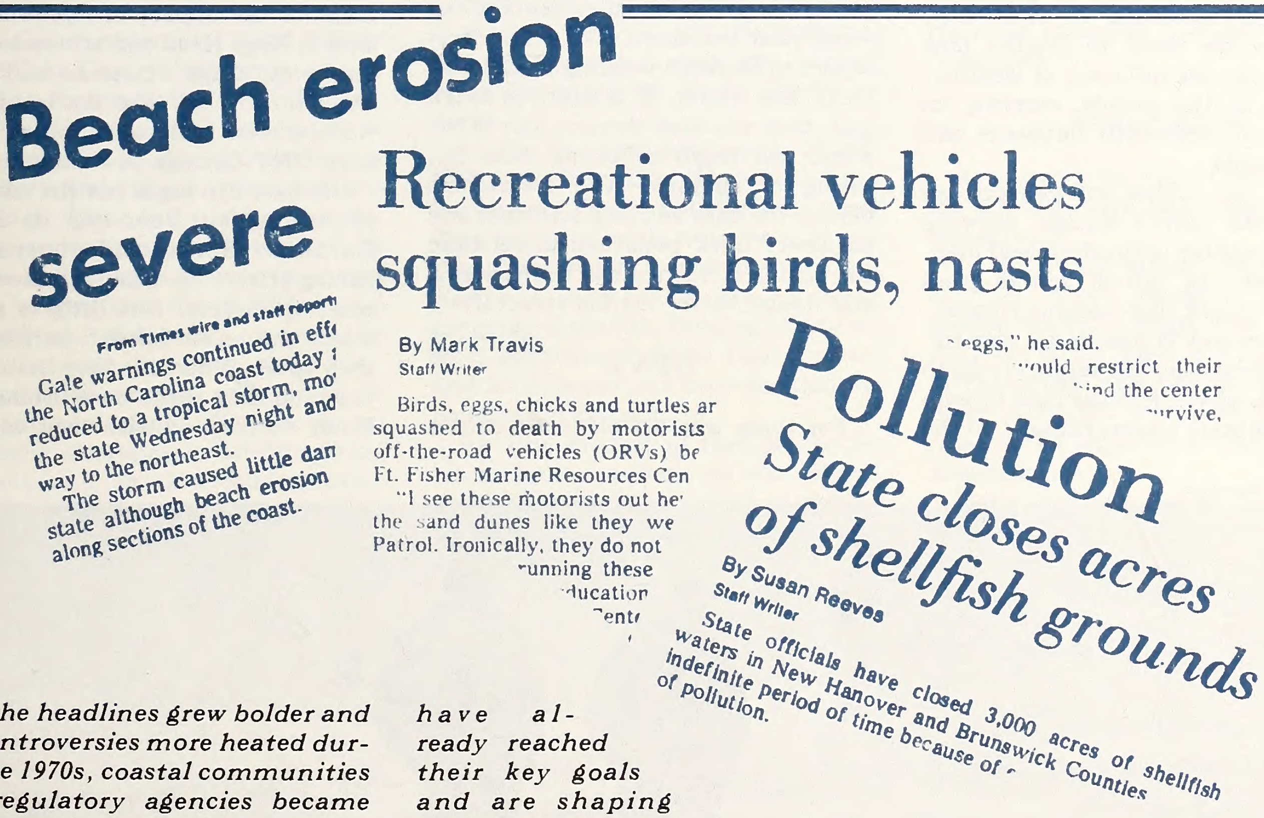
Some experts believe that the annual harvesting of bluefish smacks of overfishing. But no adequate management plan for the species can be drawn up until scientists are clear about its life history and migration patterns.

This year J.B. Sullivan of the Duke University Marine Laboratory and Chuck Manooch of the National Marine Fisheries Service office in Beaufort, will cooperate on a study designed to identify bluefish breeding pools off the North Carolina coast. If their theory that there is more than one subspecies proves correct, they plan to extend the study to other areas along the Atlantic and Gulf coasts.

Education

In Carolyn Hampton's view, North Carolina has outreached its grasp of coastal problems, and some valuable resources have been squandered. Hampton, a zoologist and ECU professor, believes students need to learn more about the coast so that they can make good decisions later.

In 1979, with Sea Grant project-initiation funds, Hampton organized at ECU a course in marine studies for prospective educators. Sea Grant has also funded the project for 1980, teaming up with ECU's established education program to introduce marine scholarship into the studies of future leaders in education. The grant provides for three fellowships. In the program, prospective teachers take the regular education courses, but include nine hours of internship in marine education. Hampton hopes students can be placed in the state's marine resources centers, or in other facilities where they can meet coastal issues head-on. Bonnie Temple of Zebulon is the first intern in the program.



Beach erosion severe

From Times wire and staff reports

Gale warnings continued in eff
the North Carolina coast today
reduced to a tropical storm, mo
the state Wednesday night and
way to the northeast.
The storm caused little dan
state although beach erosion
along sections of the coast.

Recreational vehicles squashing birds, nests

By Mark Travis
Staff Writer

Birds, eggs, chicks and turtles ar
squashed to death by motorists
off-the-road vehicles (ORVs) be
Ft. Fisher Marine Resources Cen
"I see these motorists out he
the sand dunes like they we
Patrol. Ironically, they do not
running these
ducation
Cent

eggs," he said.
ould restrict their
ind the center
urvive,

Pollution

State closes acres of shellfish grounds

By Susan Reeves
Staff Writer

State officials have closed 3,000 acres of shellfish
waters in New Hanover and Brunswick Counties
indefinite period of time because of
of pollution.

As the headlines grew bolder and the controversies more heated during the 1970s, coastal communities and regulatory agencies became more acutely aware of the need for solid information. Picking what seemed to be some of the most significant issues, Sea Grant funded research that has already led to a rethinking of regulations covering problems as diverse as wastewater disposal, off-road driving and coastal construction.

Twenty-one Sea Grant research projects are being continued this year. In some of these, researchers have already reached their key goals and are shaping their findings into final reports. For others, this year will be the year investigators come up with some new insight into some very contemporary concerns.

Erosion is still chewing away at the state's shorelines, and coastal landowners are asking: What can be done? Several teams of Sea Grant researchers studied pieces of the problem in 1979. In 1980, they will begin to put those pieces together and reach some conclusions.

Researchers Ernie Seneca and Steve Broome, both of NCSU, have concluded that marsh grasses, if adequately fertilized, can stabilize eroding shorelines along the state's sounds. At some of the test sites, marsh grasses

Continued on next page

planted in stands not only slowed erosion, but actually regained lost ground. But plantings don't always work. In some "high-energy" areas, where waves are especially frequent or intense, the grasses never get a foothold. In 1980, Seneca and Broome will continue to watch their test plantings and will try to pin down the relationship between wave energy and the growth of grasses.

Understanding shoreline erosion, and many other coastal processes, is largely a matter of understanding the movement of water. Sea Grant researchers Ernie Knowles, Bob Weisberg, Len Pietrafesa and Jerry Janowitz, all of NCSU, are using sophisticated meters and wave-monitoring gear to measure and record waves and water circulation in North Carolina sounds.

In 1979, the researchers collected enough data to conclude that their methods are accurate. In 1980, they will formulate ways to predict how water, under the influence of weather, circulates in the sounds, carrying its load of salt, sediment, nutrients and contaminants.

One of the studies will generate an atlas of the state's sounds, showing areas susceptible to flooding, and mapping zones in which marsh-grass plantings might help control erosion.

Knowles and Weisberg are also rigging equipment for the ocean, trying to determine what effect the Gulf Stream has on the state's wave climate. In the past, standard wave-prediction formulas were applied to problems like erosion, pollution and marine construction. But these models didn't adequately take into account the Gulf Stream, which Knowles and Weisberg suspect may weaken or otherwise alter wave energy off North Carolina. The new data will be useful to communities trying to solve coastal problems and will help them develop more effective plans for the management of their resources.

Currents

As Knowles and Weisberg are studying the ocean's surface, Tom Curtin and Yates Sorrell are looking under the waves to find out what's happening with underwater currents. Curtin and Sorrell, both of NCSU, have built and lab-tested an electro-magnetic sensor that they believe will help them measure and record movements of sea water near the shore. The researchers expect to launch a working model near Duck this winter. If it survives rough seas, they will float three or four in the water and begin collecting data this spring or summer. The researchers believe the data will help scientists and engineers track pollution, understand the mixing of nutrients in the currents, and design better marine structures.

ORVs

For those who use off-road vehicles to follow the fish, or just to let off steam, North Carolina's coastal terrain has been almost irresistable. But as the traffic multiplies, so does public concern: from opponents, who feel ORVs are defacing the landscape, and from supporters, who resent having their driving restricted.

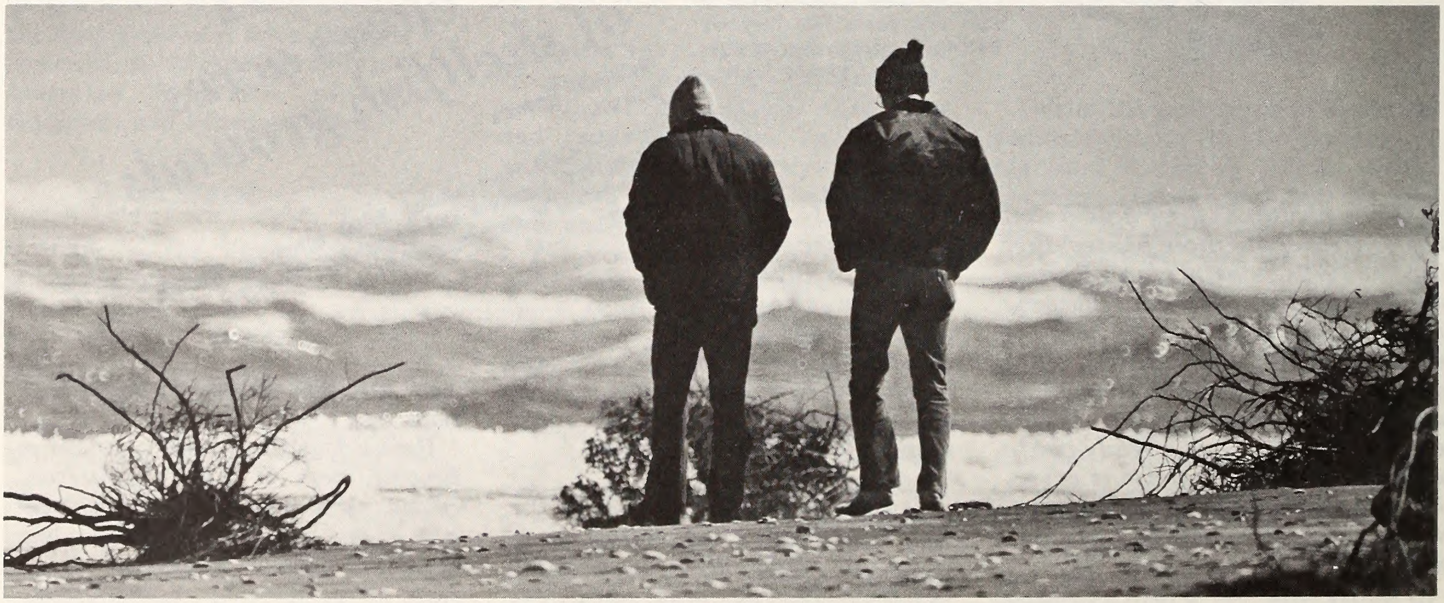
As the debate roars on, Sea Grant's Paul Hosier, of the University of North Carolina at Wilmington, has been carefully studying the beaches for hard evidence to show exactly what effect ORVs have on the coast.

Hosier has found that ORV traffic can indeed strip vegetation from dunes, marshes and grasslands. Just a few passes from a vehicle can kill grasses that need years to recover. And, as ground is bared and compacted, damage continues to underground stems and roots. All this can spell erosion.

In 1980, Hosier will continue to measure the impact of ORVs at test sites in Nags Head and at two national seashores, Cape Hatteras and Cape Lookout. He will also try to identify ways drivers and communities might keep ORV damage to a minimum.

Off-road driving is not the only sort of recreation booming in North Carolina. Sport and tournament fishing attract thousands to the state's coast each year. But little is known about the recreational fishermen and their sport: Where are they from? How much do they spend on a fishing trip? What do they do with their catches?

Photo by J. Foster Scott



Visitors pick their way through debris on a beach near Oregon Inlet, where, in 1979, heavy winter seas eroded shorelines, stranding uprooted vegetation

Where do they like to fish?

East Carolina University sociologist Peter Fricke has surveyed fishermen to find answers to these and other questions. Fricke completed his surveys in 1979, and expects to analyze the responses this year. The results, he believes, will help communities plan for the yearly stampede of recreational fishermen.

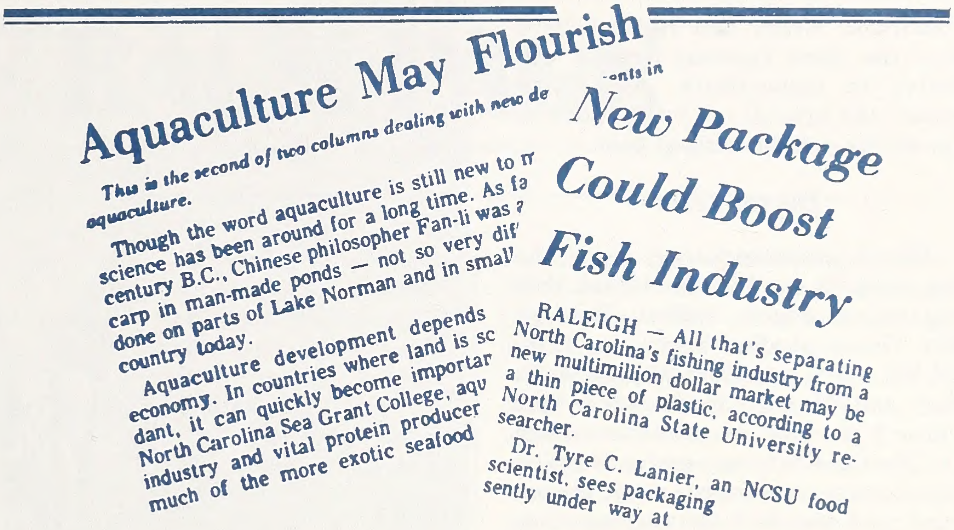
Pollution

As commercial and private development have continued to increase along the North Carolina coast, so has the problem of wastewater pollution in estuarine and near-shore waters. Shellfish such as oysters and clams are retaining bacteria and disease-causing enteric viruses from these contaminated waters. Twenty percent of the state's shellfish harvesting grounds have already been closed due to contamination.

Sea Grant researcher Mark Sobsey of UNC at Chapel Hill again will be studying contaminated shellfish. Last year Sobsey examined the rates at which the shellfish cleansed themselves of bacteria and viruses at varying temperatures. This year in a new project, Sobsey wants to find out in which body tissues and organs the contaminants settle, exactly how the shellfish purge themselves, and what causes the cleansing rate to vary with temperature. His studies will aid state shellfish sanitation officials in establishing standards for shellfish relay systems and in determining more reliable ways to evaluate shellfish quality.

Alternatives

To get to the heart of the contamination problem, wastewater pollution, Bobby Carlile of NCSU is continuing his work with alternative wastewater disposal systems for North Carolina. More than 200 of the alternative systems already designed by Carlile have been installed in 12 of the 20 coastal counties. Some counties are now using these systems exclusively to allow some development to continue. This year Carlile plans to continue his work on the alternative systems, but his main emphasis will be modifying conventional septic tank systems so that they can be adapted to the loose sandy soil and high water tables of the coastal plain.



Aquaculture May Flourish

This is the second of two columns dealing with new de
aquaculture.

Though the word aquaculture is still new to m
science has been around for a long time. As fa
century B.C., Chinese philosopher Fan-li was a
carp in man-made ponds — not so very dif
done on parts of Lake Norman and in smal
country today.

Aquaculture development depends
economy. In countries where land is sc
dant, it can quickly become importar
North Carolina Sea Grant College, aqu
industry and vital protein producer
much of the more exotic seafood

-ents in

New Package Could Boost Fish Industry

RALEIGH — All that's separating North Carolina's fishing industry from a new multimillion dollar market may be a thin piece of plastic, according to a North Carolina State University researcher.

Dr. Tyre C. Lanier, an NCSU food
scientist, sees packaging
sently under way at

In the past, when the state's seafood industry set about dividing the fishes, the "trash fish" quite often outweighed the keepers.

Every year, for instance, thousands of pounds of edible, but relatively unpopular, croaker, spot and mullet bring low prices at North Carolina's docks.

So for the past two years, NCSU food scientists Don Hamann, Tyre Lanier and Frank Thomas have been experimenting with new ways to use the minced meat from these fish. They want to determine the binding property of the fish. Binding ability affects the texture of any final product and is an important consideration for commercial companies.

As a by-product of their work, the researchers have come up with several products, including smoked salad bits, smoked sausages, luncheon meats and a shrimp-croaker product.

During 1980, the researchers will concentrate on work with surimi—washed, minced fish. Surimi is used extensively in Japan as a base for fish products. The researchers hope they can create similar products which would appeal to the American appetite. Their ultimate aim is to stimulate the development of a seafood industry in the South based on minced fish and surimi.

In a related research project begun in 1979, Lanier and Thomas are exploring other ways of boosting the seafood industry. They have found that many inland markets are closed to seafood distributors because most North Carolina processors package only fresh iced fish, which can't be shipped far or stored long.

Lanier and Thomas think that freezing fish is one solution to the problem. This year they will continue market-testing a variety of wrapping and packaging techniques to see which are the most appealing to North Carolina consumers.

Aquaculture

As early as the Fifth Century B.C., the Chinese were experimenting with aquaculture.

In the United States, aquaculture is still an infant industry, producing mainly specialty foods. One specialty food, for which there is a big demand in the Orient and Europe, is the eel. Since 1975 UNC Sea Grant has funded research on methods of culturing the American eel.

Early last year the eel farm moved to expanded facilities on the shores of the Pamlico River near Aurora. During 1980, the researchers, headed by Sea Grant associate director Bill Rickards, will continue to offer advice and information to other eel culture operations.

Next door to the eel farm, two NCSU fisheries biologists are working on another type of aquaculture project. Using tanks and grow-out ponds similar to those at the eel farm, Howard Kerby and Mel Huish are experimenting with raising hybrids from striped bass X white bass and striped bass X white perch.

The researchers are interested in the hybrids as food fish. In the wild, striped bass populations are waning, and scientists have been unable to raise this delectable fish under culture

Continued on next page

conditions. Kerby and Huish believe that the more vigorous hybrids will thrive in aquaculture. And, they report, the hybrids are just as good to eat as the popular striped bass.

Better tests

Vibrio parahaemolyticus is the big name for one little bacterium that has microbiologists baffled. Through Sea Grant studies begun in 1978, NCSU food scientists Bibekananda Ray and Marvin Speck found that vibrio is the most prevalent bacterium in North Carolina seafoods. The researchers are skeptical about the accuracy of standard tests which show that most of the *Vibrio parahaemolyticus* are non-pathogenic. This year Ray will head a new project designed to formulate a simple, sensitive test which will distinguish between the two strains.

Management

Last year's shrimp harvest of 2.7 to 2.8 million pounds was a "fair" catch after the worst harvest on record in 1978, 1.8 million pounds. But the 1979 harvest was nothing like the catches of years past, which were often 4 million to 5 million pounds.

Officials are hoping that better management policies can put the shrimp fishery back on an even keel. Researcher George Fishman of UNC-CH is developing a numercial model that will help management agencies predict the economic and biological effects of differing shrimp management policies on shrimp and other fishes. The model will be based on the biology and behavior of shrimp as well as the geographic, social and economic aspects of the North Carolina fishery.

Photo by Steve Murray

Marching as if to a fisherman's tune, two children cross a weathered footbridge at Oriental

Spot, croaker

Another researcher, John Miller of NCSU, is also working toward better fishery management policies. Miller is studying juvenile spot and croaker in their estuary nurseries to see which seasonal, environmental and biological factors most affect their abundance. So far, Miller has found that both spot and croaker rely largely on zooplankton for food. Besides a common diet, croacker and spot also seem to share habitats. But Miller wants to know what biological or environmental factors separate them and what causes their abundance to vary. By discovering these differences, officials will know how nursery management policies might affect spot and croaker and other species as well.

While researchers are grappling with some of the long-range concerns of the state's fishing industry, fishermen are struggling to adapt to shortages, new gear, rising fuel costs and increased competition.

To help them keep up, Sea Grant, working with Jim McGee of the Division of Continuing Education at ECU, is conducting courses designed specifically for fishermen. Wayne Wescott, who is coordinating the courses, has asked fishermen what they need to know, and, in response to their ideas, has conducted classes in everything from boat maintenance to financing.

Plans for 1980 include classes in electronics, safety in cold water, and survival equipment.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings and workshops, and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

To many inland city-dwellers, oysters are just things that come ready-to-eat in a carton. Coastal folks know differently. Lundie Mauldin, Sea Grant's marine education specialist, believes it's time people took some notice of the valuable oyster, which has been beleaguered of late by overfishing and pollution.

During a program called "The World of the Oyster," held Jan. 22 at the North Carolina State Museum of Natural History in Raleigh, Mauldin showed a crowd how to crack open both the shells and the secrets of the delectable shellfish. The group discussed the oyster's life history, its economic importance, its physiology and its place in coastal ecology.

Mauldin told the group that the oyster begins its life swimming, but that soon its steadily enlarging shell weights the oyster and sinks it to the bottom. If the oyster finds something solid there, it latches on and sets up housekeeping. But if it falls on sand or silt, it dies.

Mauldin also explained that an oyster can change from male to female during the course of its life. And, because oysters feed indiscriminately on plankton and other suspended matter they filter from the water, scientists can find in the oysters' bodies evidence of any pollution in their habitats.

But when the classwork was over, the group got down to what Mauldin calls "the meat of the matter": a steaming bowl of oyster stew.

If you spend any time on the water this winter, the Coast Guard has a message for you: cold water is a killer. No matter how well you swim, you'll lose body heat at an alarming rate in water less than 70°F. This heat loss, called hypothermia, can lead to death. Off the coast of North Carolina, water temperatures average less than 70°F more than half the year.

Fortunately, there are some things you can do to improve your chances for survival if you end up in cold water. The Coast Guard is conducting a series of workshops designed to teach cold water survival techniques. The workshops are aimed at boaters, commercial fishermen, waterfowl hunters, sport fishermen, emergency service personnel and others who spend time on the water.

Saturday, February 16, the Coast Guard will conduct a workshop in Manteo. Co-sponsored by UNC Sea Grant, the workshop will be held from 9 a.m. until 4 p.m. at the Old Nags Head Cove Recreation Center. Members of the Coast Guard Boating Safety Team will demonstrate the use of cold water survival suits, heat conserving postures and personal flotation devices.

The workshop is open to the public free of charge, but advance registration is required. Call the N.C. Marine Resources Center on Roanoke Island, (919) 473-3937.

The weather. Often, a fisherman's livelihood, not to mention his safety, depends on knowing exactly what the elements are up to. But many fishermen complain that the weather reports they get are designed for the public, and are too general for the fisherman's needs. Many would like regular, up-to-date data on weather systems at sea, the location of warm and cold currents, sea-surface temperatures and more. With better information, fishermen believe they could avoid foul weather and find the best fishing spots.

This year, Sea Grant is funding a study of the fishing industry's need for weather information. Jerry M. Davis, as associate professor of climatology at North Carolina State University, will ask fishermen what their needs are, study the sources of information available, and formulate ways to put the two in closer contact.

Davis believes that fishermen could benefit from a custom service like the "Green Thumb" weather program on which farmers rely.

Cold Water Drowning: A New Lease on Life presents medical findings indicating that drowning victims may be saved in spite of long submergence, particularly if the water is cold. The illustrated brochure also describes resuscitation techniques. Published by the Michigan Sea Grant Program and the U.S. Coast Guard, the brochure is available free from UNC Sea Grant.

Rip Currents, an 11" X 28½" color poster, explains what causes the dangerous currents, how to spot them, and what to do if you get caught in one. For a free copy of the poster, write UNC Sea Grant.

Sea Grant Publications, an illustrated brochure, provides a brief description of all the general-interest publications offered by the UNC Sea Grant program from 1972 to October, 1979. The brochure also includes an order form that can be used for requesting the listed publications. For a copy of this brochure or any publication listed in the Back Page this month, write UNC Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650.

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North Carolina Marine Education Manuals are designed to help middle grade educators increase the coastal awareness of their students. The manuals were designed by public school teachers and university professors for classroom use. They provide experiments, facts about the North Carolina coast, and references for further information.

UNC-SG-78-14-A *Unit One, Coastal Geology* describes the origin, dynamics and structure of the state's barrier islands and estuaries.

UNC-SG-78-14-B *Unit Two, Seawater* explains tides, waves and seawater chemistry.

UNC-SG-78-14-C *Unit Three, Coastal Ecology* describes marine habitats, adaptations sea creatures make to their environment, and a food chain.

UNC-SG-78-14-D *Appendices* provides information for constructing a marine aquarium, resources for films and magazines and a field trip guide to coastal North Carolina.

UNC-SG-78-14-E *Unit Four, Coastal Beginnings* explains the early cultures of North Carolina from the pre-colonial Indians to the first coastal communities.

North Carolina educators may receive a single copy of each manual free of charge. Prices for out-of-state requests range from $1 to $2 per unit.

Lundie Mauldin is available to introduce these manuals and the subject of marine education at teacher workshops on a county-wide basis.

If you own a marina on the Pamlico River, you may have more in common with the guy who owns a marina at Wrightsville Beach than you think. What's more, you may be able to share ideas for improving your businesses.

That's the kind of thinking that recently motivated a group of coastal marina operators to form the North Carolina Marina Association. The marina operators have been working with Sea Grant's recreational specialist, Leon Abbas, who is familiar with similar trade associations in other states.

The fledgling organization will get its official christening at a conference for marina operators scheduled for February 28 and 29 at the McKimmon Center on the North Carolina State University campus in Raleigh.

For more information on the conference, contact Leon Abbas at the Sea Grant headquarters in Raleigh, (919) 737-2454.

I want Coastwatch

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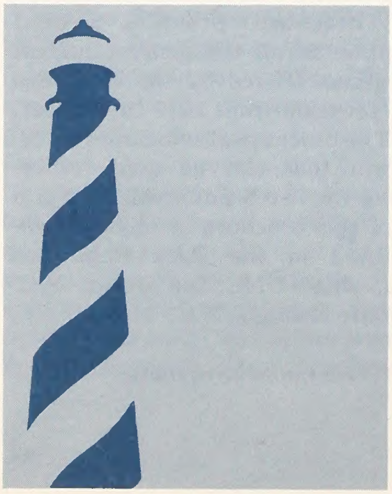

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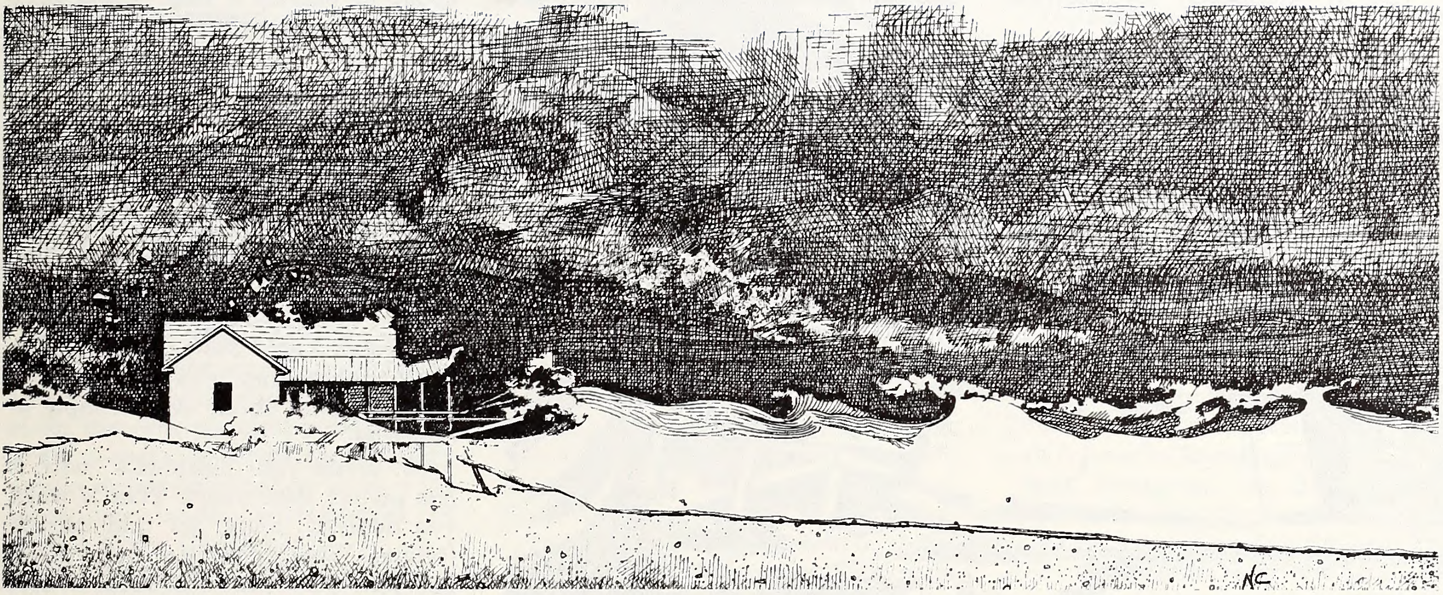
Illustration by Neil Caudle



As a hurricane moves ashore, crashing waves wrench buildings from their foundations

Hurricanes: when the roofs fly and the floors float

If you are at the coast and a hurricane warning is issued, leave. Get far away to high ground. Sure, you'll wonder what it would be like to stick around, watch the fireworks. Don't do it. Read this instead.

As the windspeed accelerates beyond 74 mph, you know you're in a hurricane (not like David, last summer. He was pooped before he got here). That's also about the time things start learning to fly. The clay flower pot just left a dent grinning in the hood of your car. The garbage can looks like Mercury I lifting off and is just about to dive through the $200 plate glass window and splash down on the coffee table. . .

Okay, maybe you had the good sense to board up those windows. The house shudders from the impact of the missile, but nothing cracks. The wind reaches about 80 mph, too much for the average roof. You can't hear them for the din of the storm, but the shingles are peeling off and sailing like frisbees. The wind shoves and lifts your roof, trying to make it into an airplane, a function for which it is fairly well designed. About now, were you in the attic, you might see the rafters rip loose from the wall, their little nails clutching air, so that the wind can really get a grip . . .

Or maybe your house was built in the last couple of years. The revised building code declares that new houses on the coast must have enough metal straps and connectors to hold everything together, so long as the blow doesn't get stronger than about 110 mph. Assume the contractor didn't fudge. Assume this is an average hurricane, not a Camille, for example, which struck Mississippi in 1969 at about 172 mph. The roof won't take wings. You shake your fist at the Big Bad Wolf, who just failed to blow your house down. Save it. He's just getting started.

If you could see through the hurtling clouds of water that have replaced the air outside, you might notice the swollen belly of the storm surge crawling landward, sucked up into a mound about ten feet higher than the mean water level, with waves breaking on top like frosting on the cake. This is when you start thinking about what's under you. It's plain that little sand dune in front of your house has about as much chance of stopping that wall of water as the Havelock High cheerleading squad has of stopping the

Continued on next page

front four of the Pittsburgh Steelers.

But as the waves chew it away, that dune is buying you time. Time to recall certain scriptures, not the least of which speaks to the practice of building one's house on sand.

What if your house is built low to the ground, on a solid masonry slab or foundation? You're sitting pretty, right? That's what the people at Holden's Beach thought in 1954, until Hurricane Hazel taught them differently. Down there, you're in the combat zone. And because buildings are bouyant, your house is about to become a boat. Floating houses come to rest in interesting, asymmetrical configurations, but on someone else's property. Even if the house has been bolted to the foundation and holds on, the surge will probably dismember it, beginning with the weakest section. Or, the water will scour soil from under the foundation, and whole sections will collapse. Or, floating battering rams—campers, picnic tables and trailers—will ram great holes in the walls. That's all the foothold the winds need to finish the job.

But let's assume, since you've been ahead of the game so far, that your house is built up on pilings, AS EVERY BEACH HOUSE SHOULD BE, and is above the storm surge. The surge passes on under the house, with nothing much down there to shove around. Don't relax yet. If the floor frame of the house is just nailed to the pilings, those waves cresting against the floor may just lift the whole house free. If the floor frame is well made, and anchored to the piles with ¾" carriage bolts for each supporting pile, and the piles are notched only an inch or so, you may be safe.

Wave action scours soil from under shallow, masonry foundations, so that walls collapse and the wind gains leverage against the roof

By now, the last of that little sand dune is washing across the street. If your pilings were sunk only about as deep as the dune, so that what used to be under ground isn't, your house is about to become a ship. Those piles will behave something like bowling pins when the next wave rolls through.

Okay, let's assume you're blessed with the perfect beach house: pilings sunk at least eight feet into the profile of the shoreline; metal bolts and fasteners holding everything together; well-fastened roofing and well-shuttered windows. Odds are you'll make it. That is, unless this baby turns into one of those "200-year storms," so called because they're expected to hit a shoreline only about every couple of centuries.

Or, unless your neighbor's house is less perfect than yours. That is when you honestly, truly, get that sinking feeling. When you see that three-bedroom house next door rock, slowly, to one side, snap its piles like pencils, belly-flop into the water, and glide straight for you. . .

Not a direct hit. Just a chunk is missing from one corner of your house, but suddenly, your house starts trembling, the water-fattened winds come blitzing through the hole. The rugs go squishy with water. The wallboard resembles something like painted oatmeal, and the siding is springing off one side of the house.

Let's say you're extremely lucky. Your well-constructed beach house is not a total loss. That is, if you can get it back together in time for the next storm. These big, bad wolves like to run in packs.

Remember? On August 30 and September 10, 1954, Carol and Edna came chasing through like pranksters. Then, on October 15, just when everybody was getting good and sick of cleaning up after hurricanes, Hazel came howling. She licked up miles of dunes, leveled hundreds of houses and killed 19 people.

How to arm buildings for life in nature's combat zone

Jerry Machemehl doesn't conduct a research project; he submerges himself in it. Paper is perched over every square inch of his office—coastal maps, erosion studies, aerial photographs, engineering calculations, hurricane records. This is one giant jigsaw puzzle, and Machemehl wants all the pieces out where he can see them.

"In the past, we've treated a hurricane as if it were a very idealized, organized storm," Machemehl says, "and that's just not the case. Few people who haven't experienced a hurricane understand what it's all about."

Machemehl is an engineer, and an associate professor of marine science and engineering at North Carolina State University. He is knee-deep in hurricane studies because, sooner or later, almost every coastal building expected to outlast its mortgage is likely to get a visit from a Hazel or a Connie or a Belle.

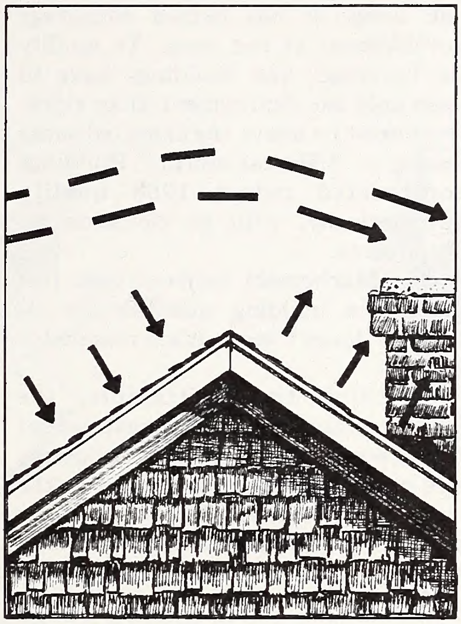
This winter, Machemehl is winding up a Sea Grant study designed to answer two key questions: What parts of the shoreline are most vulnerable to storm damage, and how can property owners armor buildings to survive the sometimes brutal environment of coastal North Carolina?

Yes, brutal. Sure, the beaches are mild and heavenly most of the year. But come winter, heavy waves and currents rake real estate out to sea. And then there are the hurricanes . . .

"Many people have not been here and were not on the coast during our major hurricane period in the nineteen-fifties," Machemehl says. "They don't understand the forces that we're dealing with."

In 1954, Hazel, the worst of a series of hurricanes in the state, killed 19 people and caused an estimated $125 million in damage. Of the 357 buildings on Long Beach before the storm, five were left intact afterward.

Largely because of Hazel, building codes and construction standards have been improved. Practically all beachfront buildings erected since the storm have been elevated to clear most storm tides. But despite these improvements, Machemehl says many new buildings going up on the coast will not stand up to a major hurricane. Part of the problem is a lack of information.



Winds lift and press roofs

Machemehl says that homeowners are not the only ones who don't know the meaning of "hurricane."

"I recently found a developer building condominiums on the coast who was not aware that there was such a thing as a hurricane in North Carolina," he says.

In fact, so little information has been available on the forces of hurricanes that architects and designers working on coastal structures have relied on formulas derived for building inland, where the only major force to contend with is gravity.

"These consulting firms are using manuals written in the nineteen-forties," Machemehl says. "The design engineer does not have an adequate manual for building in the coastal environment."

Machemehl believes the results of his study, when they are published, will change all that. His first task was to pull together data and technology already available and to initiate new research for some uncharted problems.

The most familiar culprit is the wind. A hurricane, by definition, has windspeeds of 74 mph or faster. Hurricane Camille, which hit the Mississippi coast in 1969, had gusts recorded at 220 mph—twice what North Carolina's coastal building code sets as the "design windspeed" (the force buildings must be able to withstand) for structures on the Outer Banks. And, as windspeeds increase, the forces they exert on a building increase manyfold, so that the 125 mph wind of a severe hurricane would exert about five times the force of a 60 mph wind.

Hurricane winds over 100 mph are infrequent in North Carolina. Meteorologists estimate that such storms occur on the coast about once every 100 years; hence the term "100-year storms." But there are no guarantees that two such monsters won't come in the same week.

"Hurricane-force winds can occur anywhere on the North Carolina coast," Machemehl says. "A rule of thumb would be that any structure built in an area where there are high winds and wave and surge forces should be tied together from the tip of the roof to the bottom of the foundation, so that there is an integrity among all the parts, and the structure acts as a unit."

To "tie" a building together, contractors use corrosion-resistant metal straps and anchors, rather than nails alone, to attach roof parts to walls, and wall frames to foundations.

But designing for high winds, Machemehl says, is far easier than designing a building to withstand the other big bandits in a hurricane: the storm surge and waves.

The storm surge is a dome of water pushed up by the combination of rotating storm winds and atmospheric low pressure during a hurricane. It is not a wave. It is a gross distortion in the water level that can stretch as much as 100 miles along the coastline. During Hazel, the surge rose 11 feet above mean sea level, topping dunes and submerging whole islands. During Camille, the storm surge rose to 23 feet.

Breaking waves and swells ride the top of this surge inland. In many cases, erosion during the hours preceeding a storm carves away great quantities of sand from the dunes. The weakened dunes can do little to protect the structures behind them.

"The dunes are only a reservoir of sand," Machemehl says. "They are not really adequate hurricane protection."

As the water surges inland, more

Continued on next page

forces assault the buildings there. The surge itself lifts many structures, which are bouyant, right off their foundations. The water, as it passes, also creates a "form drag," a force that tries to tug the building along with the flow. Once the building is freed from its underpinnings, it too becomes a destructive force.

Machemehl describes the scene as a large storm surge moves ashore:

"Those structures on slabs would tend to be picked up and floated away, and they would become battering rams against the other structures. The beach profile would recede, and some of the structures on piles would overturn because their pile foundations were not deep enough. As the surge came in, the exterior walls of many buildings would be destroyed."

How will the state's coastal buildings fare during all this lifting, dragging, smashing and blowing, the next time a hurricane comes? Not well, Machemehl says.

"Some of our structures, maybe fifty to sixty percent, would be destroyed in a one-hundred-year-frequency storm," he says, "and possibly all of them with a two-hundred-year-frequency storm."

"The exterior walls of many buildings would be destroyed"—Jerry Machemehl

The "two-hundred-year storms," the extreme hurricanes like Camille, show up every couple of centuries. They leave very little trace of civilization in their wakes. Engineers don't even bother designing structures to resist them.

"It would be impossible to design and build a structure that would survive all events," Machemehl says.

The building most likely to survive an extreme hurricane would be one of cast concrete (not concrete blocks), reinforced with steel. Something like a bunker or a pillbox. But not many people want to spend their vacations in pillboxes, and concrete and steel, while practical for large motels and hospitals, are far too expensive to be used extensively in houses.

Building almost anything within reach of the sea is a risk many have found worth taking partly because of federal flood insurance.

Federal flood insurance was begun in 1968 and is available for buildings in all the nation's flood-prone areas. Since the program offers, through private companies, low-cost insurance in high-risk areas, it has helped encourage development at the coast. To qualify for coverage, new buildings have to meet only one requirement: floor elevations must be above the expected surge during a "100-year storm." Buildings constructed before 1968 qualify automatically, with no elevation requirements.

But Machemehl believes that just because a building qualifies for insurance doesn't mean it's a reasonable risk.

"I think the contractors, the engineers and architects must accept their responsibility to refuse to design and build inadequate structures on the coastline," he says. "That insurance program is a program underwritten by the government. So that if there's great destruction in an area because of the quality of construction, then, in general, everybody pays for it."

Machemehl says builders weaken structures by using too few metal anchors, by using paper or "fiberboard" rather than wood or plywood for sheathing, by using piles that are too shallow, by skimping on roofing materials and by failing to adequately secure porches, overhangs, awning and corners.

Since it became necessary to elevate new beach residences in order to meet insurance requirements, wood pilings have sprouted like forests under new houses at the beach.

"The reason to put a house on piles is to get up above the storm surge," Machemehl says.

Most of the state's new beach houses have an elevation of sea level plus 12 feet—just enough to clear another 100-year storm like Hazel, whose surge reached 11 feet. Piles also have the advantage of allowing water to pass under the building, and so don't absorb much of the force. Wall foundations, especially those of concrete block, perform very poorly during hurricanes.

Almost as soon as he began putting together his picture of buildings in coastal hazard zones, Machemehl found several pieces missing.

There were, for one thing, no reliable data on the pressure exerted by waves cresting against the floor of a building. So an NCSU graduate student, under Machemehl's direction, began using scale models, a mechanical wave tank and electronic pressure transducers to determine wave uplift under buildings. Machemehl believes that when the study is finished, sometime this year, information will help designers determine how strong floor structures and their connections to piles must be to resist waves.

Missing, too, was information on the speed and extent of erosion likely during storms on the coastline—information vital to engineers trying to calculate how deep piling foundations should be.

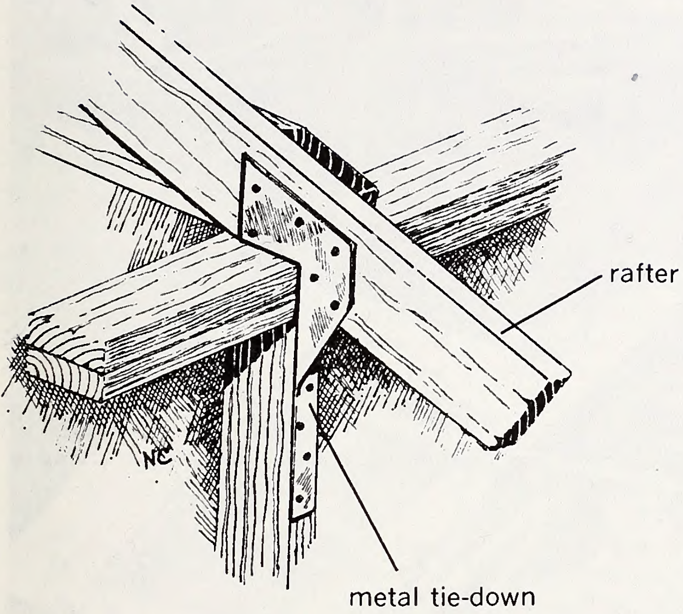
"Right now, nobody can say how deep piles should be," Machemehl says. "Some say eight feet below the profile, but that may not be deep enough."

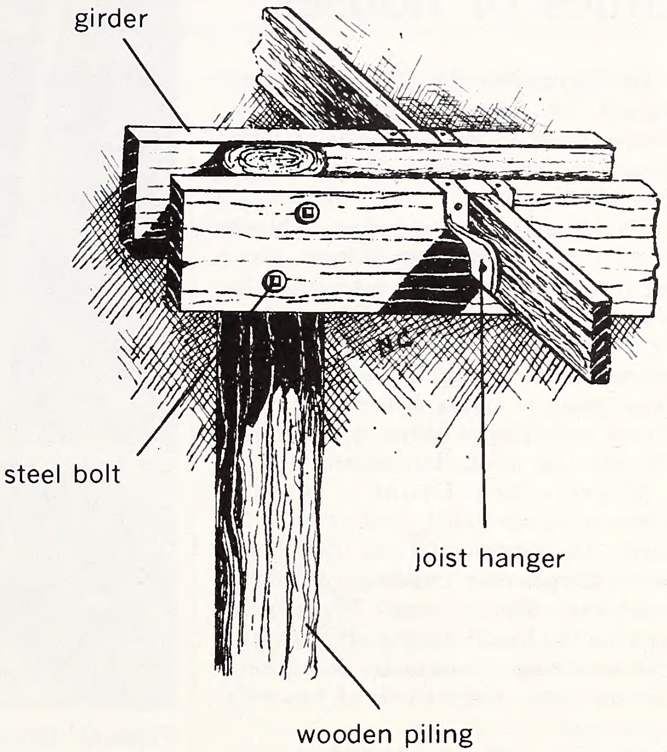
Machemehl has been devising a numerical model that could project the rate of erosion for building sites along the coast.

In another Sea Grant study, Stan Riggs, Mike O'Connor and Vince Bellis of East Carolina University found ways to predict how susceptible estuarine shorelines are to erosion. Their methods for predicting erosion are described in a flyer, "Relative Estuarine Shoreline Erosion Potential in North Carolina," which is available from the Sea Grant office in Raleigh.

But even though there are still questions to be answered, the profile of a durable beach structure is already clearer: The building site should be well behind the primary dunes. The pile foundation should reach at least 8 feet into the profile of the shoreline, not including the depth of the dunes. Piles should be bolted to the floor structure. Walls should be braced with rigid wood or plywood sheathing. All corners, overhangs and other windcatchers should be well-anchored. And the whole building should be tied together with metal connectors.

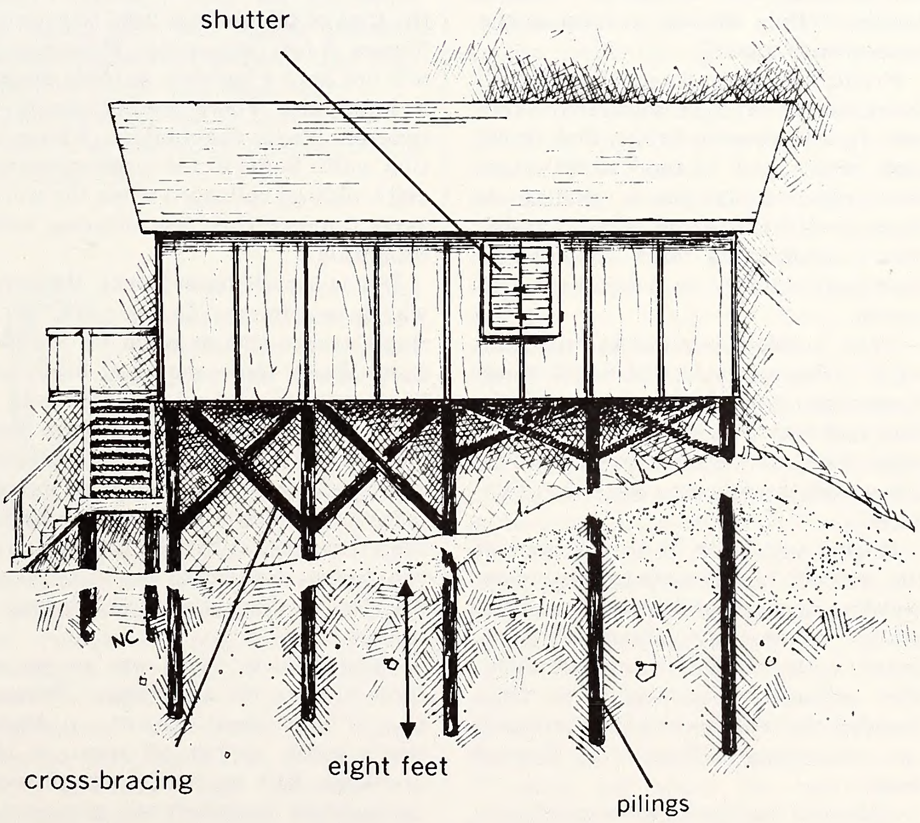
Of course, the most hazardous building sites are generally those on the beachfront, where erosion and wave action are most intense. But even sites several blocks from the shoreline are vulnerable to flooding, winds and floating or blowing debris.





Storm-proofing

Houses in hurricane-prone areas need to be constructed to resist the action of wind and water. Metal tie-downs (above left), used with each rafter, secure the roof frame to the walls. Steel bolts installed in girders and pilings (above right) anchor the floor structure to the foundation. Pilings under beach houses (right) should be cross-braced and should penetrate well below the beach profile. Windows should have sturdy storm shutters.



'Frederic' erased miles of houses

Photo by Jerry Machemehl

Frederic left open wounds in many Gulf Shores buildings

On September 23, Spencer Rogers picked his way through the odd, broken stumps in the beach of Gulf Shores, on the eastern side of Mobile Bay, Alabama.

The beach was deserted, almost barren, as if it had been shaved, leaving just the stumps, like razor stubble, poking through the sand. Eleven days before, those stumps were the wooden pilings under houses, dozens of them. Now most of those houses, or what pieces remained of them, were strewn through the woods far inland.

Rogers, Sea Grant's coastal engineering specialist, had come with Jerry Machemehl to see first-hand what happens to buildings during a hurricane. Rogers and Machemehl were on the beach, taking photographs and searching the ruins for clues, long before the major cleanup was underway.

"That stretch of beach had been almost completely developed," Rogers recalls. "When we saw it, most of the houses were gone."

Frederic was not an "extreme" hurricane, or even an unusually severe one. It was about average. But its 90 mph winds and 12-foot storm surge had reshaped the coast, eroding as much as 100 feet of shoreline, topping dunes, submerging miles of land and wrecking houses, condominiums and motels.

"The problem was not so much the wind," Rogers says. "Most of those houses could have taken the winds. The problem was that the pilings, in most cases, were either too short or inadequately attached to the floor structure."

Rogers says that he found most of the wrecked houses were toppled when erosion removed sand from around the pilings. When key pilings were exposed, with no sand to support them, they collapsed. Unbalanced on their foundations, the houses then snapped the remaining pilings and floated away.

"Most of the destruction could have been prevented if they had just had those pilings eight or ten feet deep, instead of four or six," Rogers says.

There were clues other than the stumps. There were empty nail holes in the tops of pilings that used to support houses. A few little spikes, Rogers says, will not hold a building in place during a hurricane. There were mounds of concrete block, the remains of foundation walls. Some of the larger commercial buildings collapsed when the storm surge rammed their load-bearing walls broadside.

In the mobile home parks, the story was even grimmer. In one park, not a single trailer remained on its foundations. Even those that had been tied down were kicked around like cans.

What can North Carolina learn from the tragedy at Mobile Bay? Rogers and Machemehl say that even though many of our newer buildings are better than those lost at Mobile Bay, much of the destruction would be repeated on the North Carolina coast during a similar storm.

"The hardest thing was to get all those houses up on pilings," Rogers says. "Now that they're up there, that's going to cut off most of the problems. But we need to work with the building inspectors and contractors to see that the pilings are deep enough and the fastening techniques are strong enough."

Toward that end, Rogers has put together a slide show that he is presenting to groups of contractors, building inspectors, civic leaders and property owners. The slides include many of the shots he took at Mobile Bay, plus some examples of vulnerable buildings on the North Carolina beaches. (People interested in having Rogers speak to their groups can contact him at the Marine Advisory Service office in the N. C. Marine Resources Center/Ft. Fisher, 458-5780).

With other experts, Rogers also has been working out ways to define an "ocean erodible area" for the Coastal Resources Commission, which issues permits for beach development. The ocean erodible area is the part of the shoreline, nearest the beach, that is likely to be eroded over 30 years (including the erosion expected during one 100-year storm).

Rogers is also helping the state to estimate the amount of destruction that might result if a severe hurricane were to hit a segment of the state's coastline. The investigators have chosen Surf City as their model, and will consider possible waves, tides and winds to predict which buildings would be lost, which would survive, and what the damage would add up to in dollars and cents.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

The TV cameras have been moving in on Tyre Lanier's lab at North Carolina State University (NCSU). In mid-January, a Durham station filmed Lanier at work on his current Sea Grant project. The spot was subsequently picked up by CBS affiliates all over the country.

What's causing all the stir is a product Lanier has cooked up, with the help of NCSU scientists Frank Thomas and Don Hamann. Lanier starts with minced fish and shrimp, which he grinds into a paste, squirts into a metal mold and heats briefly. Presto: whole shrimp. According to Lanier and others who have sampled the product, it's as good as most frozen whole shrimp. And, if it makes the commercial market, as Lanier predicts it will, the product will probably sell for about half the price of whole breaded shrimp now available in grocery stores.

The new product is similar to "refabricated shrimp" (minced shrimp pressed into a shrimp shape) now on the market. But it actually contains between 50 and 75 percent fish. It's all part of Lanier's scheme to develop ways to make better use of some unpopular fish, including the abundant croaker. Lanier is particularly interested in using surimi, or washed, minced fish, which is used as a base for many products in Japan. He contends that the excellent texture of surimi is what makes his new product so good.

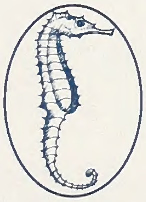
The traditional seafood platter costs a bundle these days, but there are still bargains in the seafood market.

To help keep consumers informed about seafood's role in good nutrition, Sea Grant, in cooperation with the N.C. Agricultural Extension Service, will sponsor a three-day training session for county home economics and extension agents.

The aim of the session is to bring North Carolina agents up-to-date on developments in the seafood industry. The agents will use the training to keep their communities abreast of changes in the industry, and to show families how to prepare nutritious, economical seafood dishes.

In the workshop, agents will visit marine laboratories and seafood processing companies, and will learn about the latest techniques for handling and preparing seafoods. Sea Grant's advisory staff will introduce the agents to several "under-utilized" species—unfamiliar seafoods that offer plenty of flavor and food value.

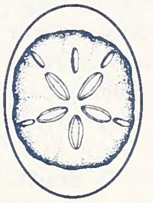
The workshop will be held March 11, 12 and 13 at the NCSU Seafood Lab in Morehead City.



If you're considering graduate study in marine science, then Sea Grant may be able to offer you some needed financial aid. Every year Sea Grant awards graduate fellowships to students for marine research and study. This year two fellowships are available and applications are now being accepted.

Prospective graduate students from any recognized public or private institution are eligible. Recipients must be accepted by graduate programs at the University of North Carolina at Chapel Hill (UNC-CH), North Carolina State University in Raleigh, East Carolina University (ECU) in Greenville or the University of North Carolina at Wilmington (UNC-W).

For more information and applications, contact Jay Langfelder, Department of Marine Science and Engineering, NCSU; Dirk Frankenberg, Curriculum in Marine Science, UNC-CH; William Queen, Institute for Coastal and Marine Science, ECU; Gilbert Bane, Program for Marine Sciences, UNC-W; or UNC Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650. Completed applications must be returned by April 1.



This summer, Sea Grant will again offer three workshops designed to help school teachers enrich their students' studies of coastal North Carolina.

Lundie Mauldin, Sea Grant's marine education specialist, is organizing the workshops, which will offer teachers course credits through the Continuing Education Department at NCSU.

The first workshop, to be held June 22-28 at the N.C. Marine Resources Center/Ft. Fisher, is planned for fourth-, fifth- and sixth-grade teachers. The teachers will study the ecology of marshes, beaches and islands, will make field trips to historic sites, and will try their hands at fishing, clamming and collecting samples of marine life. Tuition for the workshop is $50.

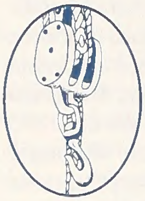
Another workshop, to be held June 22-28 near Gloucester, will be conducted by archaeologist David Phelps of ECU. Phelps will lead teachers on an archaeological dig where they will learn how to excavate, collect, catalog and interpret Indian artifacts. Tuition for this workshop is $50 and teachers from any grade level may apply.

The third workshop, for seventh-, eighth- and ninth-grade teachers, will be held July 13-26 at the N.C. Marine Resources Center/Bogue Banks. Teachers will study the specialized occupations that have developed because of resources present in the coastal environment. Field trips will include visits to boatbuilders, fishing

Continued on next page

villages and research labs. Tuition for the workshop is $100.

For an application to enroll in any of the workshops, write: Lundie Mauldin, UNC Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650. Applications must be returned by April 18.



Sport fishermen once reeled in Spanish and king mackerel by the dozens off the North Carolina coast. But things have changed. Charterboat captains say fewer and fewer mackerel are being caught each season. Why? Many blame commercial fishermen in Florida, who are now catching large quantities of the mackerel with gill nets and seines. Because the mackerel migrate north and south each year, large catches in Florida may affect catches in North Carolina.

The Gulf of Mexico and South Atlantic Fishery Management Councils are concerned about the dwindling numbers of Spanish and king mackerel. Together, they have drafted a plan for the management of the fishery along the Gulf coast and the Atlantic coast from Florida to North Carolina. The plan also includes management plans for cobia.

The councils will present the proposed plan for public comment at three North Carolina locations—March 10, Hatteras Civic Center, Hatteras; March 11, Carteret Technical Institute auditorium, Morehead City; March 12, Hilton Inn, Wilmington. All three meetings will be held from 7 p.m. until 10 p.m. Anyone can attend. Comments by the public will be reviewed before the final management plan is adopted.

If you would like to know more about the South Atlantic Fishery Council, write for a free brochure—UNC Sea Grant, Box 5001, Raleigh, N.C. 27650.

Maybe you have been watching the shoreline in front of your beach house wash away and were wondering what you could do to slow the erosion. Then you might be interested in attending a workshop about planting dune and marsh grasses to stablize shorelines.

The workshop will be held at the Marine Resources Center at Bogue Banks on April 9 at 10 a.m. Sea Grant researcher Ernie Seneca of NCSU and Carteret County Agricultural Extension Agent Jim Bunce will conduct the workshop with the help of Bob Hines, Sea Grant marine advisory agent. Workshop participants will also get some practical experience planting grasses.

I want Coastwatch

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant. Box 5001, Raleigh, N.C. 27650.

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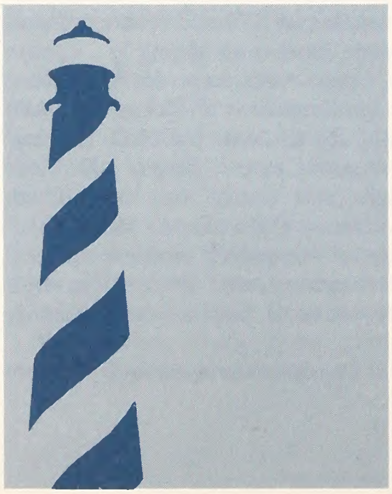

UNC Sea Grant

March, 1980

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COASTWATCH

A fisherman harvests oysters from an uncovered bed

Sorry we're late

On its way to publication, the material we'd originally planned for the March and April issues of *Coastwatch* hit a snag and had to be abandoned. Fortunately, there's plenty more to report, and we'll catch up with the calendar as quickly as we can.

— The editors

When 'progress' Is a dirty word

Alton Phillips remembers a time when oyster fishermen could tong a skiff full of oysters from one oyster bed in Queen's Creek without ever having to pull up anchor to change locations. The oysters are still bedding in the creek, but now fishermen can't harvest the shellfish because they have been contaminated by pollutants.

"Pollution is taking over," says Phillips, a 56-year-old Swansboro fishermen who depends now on clamming to make a living. "People call it progress and progress is supposed to be good. In a way it may be, but in a way it's not."

Phillips says that state and local health officials first told him and other fishermen the creek's pollution was coming from a nearby trailer park. After the trailer park was shut down and the pollution persisted, Phillips says officials decided effluent from a nearby sewage treatment plant was polluting the lower part of the creek.

"They fixed the sewage treatment plant, but now they tell us the pollution is coming from developments and run-off upstream," Phillips says. "You can't win. There seems no way it will ever be cleaned up now. There's too much going on."

Phillips claims motorboats churning up the water, and run-off from farms and development cloud the water with silt. "I was born and raised right here on the creek," Phillips says. "And when I was a boy it was seldom that the water wasn't clear enough to see the bottom. But this winter, the water

Continued on next page

Photo by Steve Murray

At low tide, three fishermen rake for clams at Harkers Island

was the dirtiest I have ever seen. It was near like coffee."

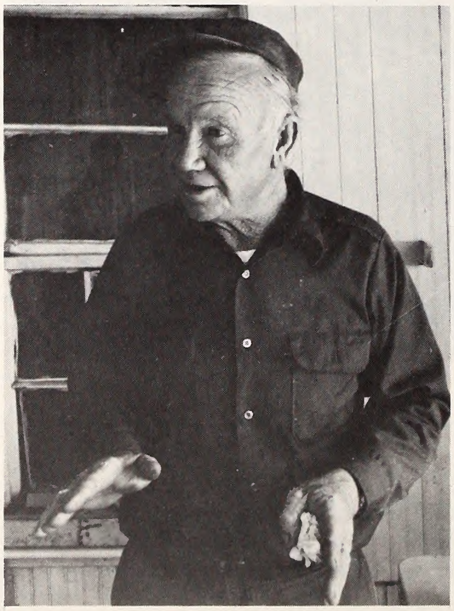
The heavily silted water stunts the growth of oysters and clams in the creek and sometimes even smothers them, Phillips contends. The silt and mud also coat the hard shells and rocks that litter the creek bottom, Phillips says. Young oysters and clams, called spat, attach themselves to hard surfaces before they build their shells. If the shellfish land on silt or mud, they die. Phillips says the silted bottom has cut down on oyster and clam production, which was once plentiful in the area.

"This may sound crazy," Phillips says with a chuckle, "but what we really need is a good hurricane, if you can call hurricanes good.

"In 1947 and '48, oyster and clam production was kind of like it is now because the bottom was all silted. But after we had all those hurricanes in 1954 and '55, the bottom got cleaned up. The oysters and clams had something to catch on and production went way up for a while. Then in 1960, the bottom began to silt over again and the number of oysters and clams we harvested began to drop."

Phillips says there were once a lot of oystermen in the area. "My father used to depend on oystering for a livelihood when I was a boy," he says. "But the creek got polluted and he had to quit because the waters were closed."

Photo by Neil Caudle



Alton Phillips

Once an oysterman himself, Phillips has turned to "gardening" clams. He leases unpolluted creek bottoms, called gardens, from the state and transfers clams from polluted waters to the clean waters of his garden. Phillips must keep the clams in the garden at least two weeks before they can be harvested and marketed. He is one of the few fishermen in the state to have applied for a permit to relay contaminated clams.

"There's too many people clamming these days," Phillips says. "The clam beds are overworked. We've got to have a clam season or our clams won't hold out much longer."

To make sure he'll have enough clams for next year's chowder, Phillips also operates a clam hatchery. He nurtures clams from the larval stage until they have three-quarter-inch shells. Then he places them in his clam garden to grow much like farmers do tobacco in their fields.

Phillips says it takes a lot of work and extra time to get a good bushel of clams now. "It's a hard manner for a man to make a living fishing these days," he says.

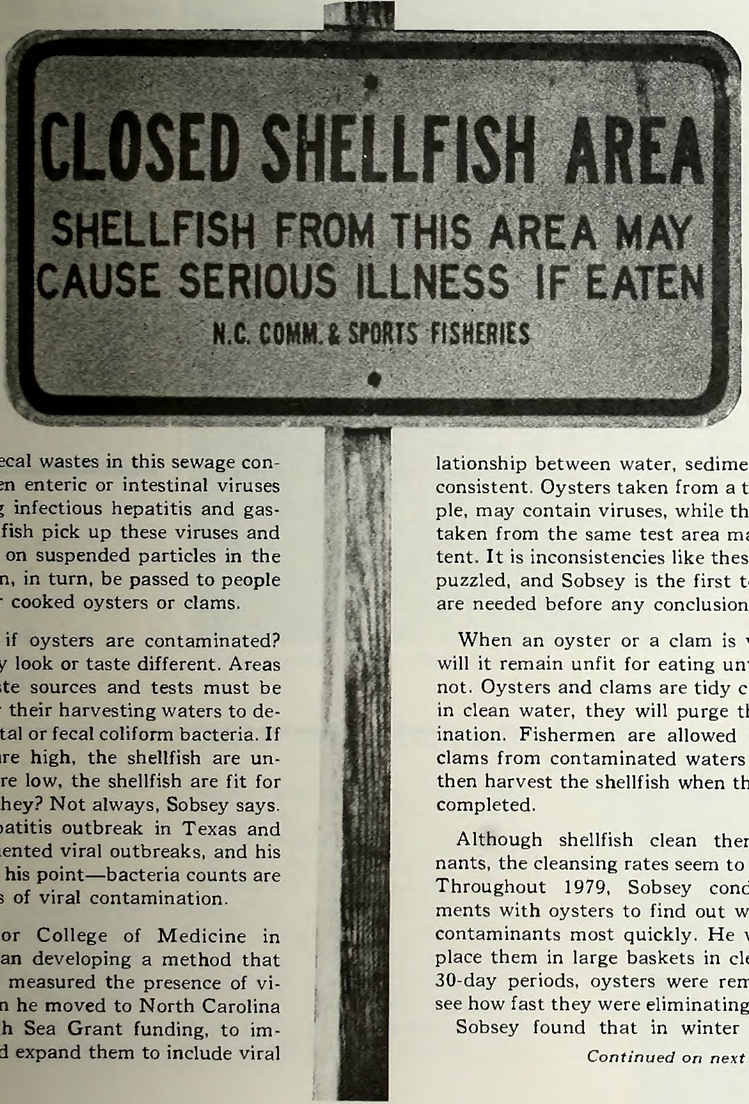
Researcher questions shellfish standards

In 1973, 263 people in Houston, Texas, and 15 people in Calhoun, Georgia caught infectious hepatitis after all of them had eaten oysters harvested from the lower Mississippi River. The oysters were virally contaminated. Yet according to the bacteriological standards set by the National Shellfish Sanitation Program, the oysters were safe for consumption.

Deduction? The standards are not adequate indicators of viral contamination in shellfish. Answer? Better tests and more research are needed. Enter: Mark Sobsey, one of several scientists around the country working to improve shellfish sanitation.

Sobsey, a UNC Sea Grant researcher and an associate professor in the department of environmental sciences and engineering at the University of North Carolina at Chapel Hill, has been conducting research since 1974 to improve shellfish standards and learn more about the viral contamination in oysters and clams.

How do oysters and clams become contaminated? Sobsey says that frequently sewage treatment plants and malfunctioning septic tanks allow partially treated or untreated sewage to flow or seep into shellfishing waters. Fecal wastes in this sewage contain bacteria and often enteric or intestinal viruses such as those causing infectious hepatitis and gastroenteritis. The shellfish pick up these viruses and bacteria as they feed on suspended particles in the water. The viruses can, in turn, be passed to people when they eat raw or cooked oysters or clams.


CLOSED SHELLFISH AREA
SHELLFISH FROM THIS AREA MAY
CAUSE SERIOUS ILLNESS IF EATEN
N.C. COMM. & SPORTS FISHERIES

How do we know if oysters are contaminated? They don't necessarily look or taste different. Areas are surveyed for waste sources and tests must be run on the shellfish or their harvesting waters to determine the level of total or fecal coliform bacteria. If the bacterial levels are high, the shellfish are unmarketable; if they are low, the shellfish are fit for consumption. Or are they? Not always, Sobsey says. He points to the hepatitis outbreak in Texas and Georgia, other documented viral outbreaks, and his own research to make his point—bacteria counts are not reliable indicators of viral contamination.

In 1974 at Baylor College of Medicine in Houston, Sobsey began developing a method that directly detected and measured the presence of viruses in oysters. When he moved to North Carolina he continued, through Sea Grant funding, to improve his methods and expand them to include viral detection in clams. Using a blender, centrifuge, filters and other simple laboratory equipment, Sobsey is able to recover enteric viruses from oysters. Now other scientists throughout the country have adopted his detection method, with some variations of their own. The Food and Drug Administration is currently testing methods used at various laboratories, including Sobsey's, to see which is the most accurate.

Using his methods of viral detection and the older methods for bacterial detection, Sobsey has been testing the relationship between viral and bacterial contamination in shellfish, water and sediment. He has set up testing stations at various intervals downstream from a sewage treatment plant on the North Carolina coast.

"So far, we've found no consistent relationship between virus and bacteria levels," Sobsey said. "Sometimes we have oysters with a high virus count yet a low bacteria level. Other times we have just the opposite. How can we use these bacterial standards to measure viral quality of the shellfish if they can't even indicate viral presence?" he asks.

Sobsey has also found that the relationship between water, sediment and shellfish is inconsistent. Oysters taken from a testing area, for example, may contain viruses, while the water and sediment taken from the same test area may show no viral content. It is inconsistencies like these that leave scientists puzzled, and Sobsey is the first to say that more tests are needed before any conclusions can be made.

When an oyster or a clam is virally contaminated, will it remain unfit for eating until it dies? No it does not. Oysters and clams are tidy creatures. Once placed in clean water, they will purge themselves of contamination. Fishermen are allowed to relay oysters and clams from contaminated waters to clean waters, and then harvest the shellfish when the cleansing process is completed.

Although shellfish clean themselves of contaminants, the cleansing rates seem to vary during the year. Throughout 1979, Sobsey conducted relay experiments with oysters to find out when they flushed out contaminants most quickly. He would experimentally place them in large baskets in clean water. In several 30-day periods, oysters were removed periodically to see how fast they were eliminating viruses and bacteria.

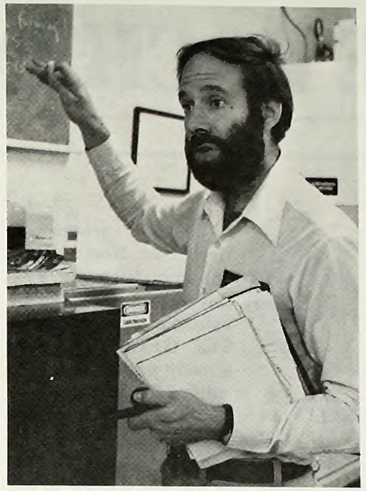
Continued on next page

Sobsey found that in winter months when water temperatures are low, the oysters were only modest housekeepers. After three days in clean water, 5.5 percent of the viruses remained in the oysters; after 30 days .006 percent of virus remained. The oysters tested in April and May, however, did their spring cleaning at faster rates. Only .04 percent of the viruses remained after three days and after thirty days .005 percent remained. Sobsey also tested for bacterial elimination and found similar cleansing rates.

Sobsey expected the oysters to eliminate viruses and bacteria at faster and faster rates as the water temperature rose. But the oysters became lazy in hot weather.

"I was surprised", says Sobsey. "The viral elimination dropped off drastically when water temperatures were high, and I am not sure why." Sobsey says the warmer water could cause the oyster to become extremely sluggish and therefore reduce the rate at which they flush water through their bodies. Or the viruses could become sequestered in the shellfish tissue because of changes in the shellfish physiology during spawning.

Photo by Neil Caudle



Mark Sobsey at work

Sobsey intends to continue his relay experiments this year.

In the relay experiments, Sobsey again found the inconsistent relationship between viruses and bacteria. During the summer months, when viruses were persistent in the oysters, bacteria were not. Bacterial elimination in oysters during summer continued at similar rates as in the spring tests. These findings led Sobsey to question how fast the shellfish became contaminated with viruses and bacteria, in which body organs the contaminants settled, and how conditions like temperature, salinity and turbidity affected how long the bacteria and viruses persisted. This year, Sobsey and graduate students will be trying to answer these questions. The answers could have implications for regulations governing shellfish relay.

As development continues along our nation's coastlines, more pollution is being dumped into our bays, rivers and sounds. This pollution is contaminating thousands of acres of shellfish growing waters. One-fifth of North Carolina's shellfishing waters have been closed. Will more shellfishing waters need to be closed? Or once the tests for contaminants are improved, will some waters be closed while others are re-opened? The work of Sobsey and others may soon help answer these questions.

Pollution hits Brunswick County fishermen hard

In Brunswick County, numbers tell a sad story. The county has 22,500 acres of shellfish waters, and 18,830 of them, or 83.5 percent, are closed because of pollution—pollution from sewage treatment plants, malfunctioning septic tanks, farms, drainage areas, construction sites and industry.

Many long-time Brunswick County shellfishermen are hanging up their gear for other occupations or moving to other counties because of the problem, says Loyd Ward, president of the Brunswick County Commercial Fishermen's Association, a 550-member association organized to draw attention to the fishermen's plight.

"Out county is a disaster area," he says. "And if something isn't done in the next two years, the seafood industry will become non-existent in Brunswick County."

Officials aren't as pessimistic, but everyone agrees the problem is serious. The N.C. Department of Natural Resources and Community Development has developed a ten-point "action plan" for the county.

Among other things, the plan calls for relaying oysters from polluted to non-polluted waters and depositing empty shells or cultch to make beds on which the spat can attach themselves. The plan asks for careful monitoring by the state Division of Marine Fisheries and the Shellfish Sanitation Division to allow conditional openings when coliform counts meet FDA standards and for a study to be conducted into opening some inlets so estuarine waters could better be flushed by tidal fluctuations.

The plan also suggests a study be made by the Environmental Protection Agency to see what effect sewage disposal along South Carolina's Grand Strand has on North Carolina waters. In a 1972 study, the EPA found some of Brunswick County's problems coming from inadequate sewage disposal along the Grand Strand. Since then, some improvements have been made and an update is needed.

Brunswick County fishermen, however, aren't the only ones suffering. In nearby New Hanover County, 58 percent of the shellfish waters are closed. But Fentress "Red" Munden, shellfish coordinator for the state Division of Marine Fisheries, offers some hope. In 1974, 668,335 acres of estuarine waters were closed, he said. In 1979, the acreage had decreased to 419,676.

Michael Marshall, a shellfish biologist with the Division of Marine Fisheries, says the state is not only helping Brunswick County, but other counties as well. "Last year, we spread 200,000 bushels of cultch material from Manteo to the South Carolina line," he says. And in addition to relaying contaminated shellfish, the state also transfers undersized shellfish to better waters. Marshall says the division calls its oyster programs "oyster rehabilitation."

Marshall says the state also allows fishermen to do their own relaying from polluted waters to clean waters as long as they obtain a permit, lease approved bottom areas and meet state requirements for leasing and relaying.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

With spring comes the migration of young eels, or "elvers," into North Carolina's coastal rivers and streams. But many things about the annual migration are unknown: How many eels are there? How many survive the trip upstream? How fast do they travel?

The answers would help scientists learn what effect the increasing harvest of eels, both for sale and for use in aquaculture, is having on the eel population.

This spring, with Sea Grant support, researchers are field-testing two techniques for marking young eels. In one method, elvers are immersed in a florescent pigment; in another, they are sprayed with rhodamine B dye. Both stains show up only under ultraviolet light.

Wilson Laney, a graduate student in zoology at North Carolina State University, is marking elvers caught near Lake Mattamuskeet in Hyde County. The marked eels are returned to the water, where they can continue their journey. Later, a mile or two upstream, Laney will make regular samplings to see how many of the marked elvers turn up. If the system works, researchers will be able to compare the numbers of marked and unmarked eels in the samples. Using these methods, it may eventually be possible for scientists to estimate how many eels can be taken from the state's waters without endangering the eel population.

Three researchers from two North Carolina universities have received grants that will be valuable in furthering Sea Grant projects already under way.

Seafood scientist Tyre Lanier of NCSU has received $10,000 from the South Atlantic and Gulf Fisheries Council to work on seafood marketing. Lanier will use the money to expand his Sea Grant project on improving the quality of packaged seafood.

Another seafood scientist, Frank Thomas of NCSU, received a grant from the N.C. Board of Science Technology to set up and operate a steam generator for canning seafood. Installed at the NCSU Seafood Laboratory, the generator will allow Thomas and other researchers to test canning operations and improve marketing for some seafoods.

Margie Gallagher, a nutritionist at East Carolina University, also received a grant from the Board of Science Technology. Gallagher will use her grant to purchase analytical equipment for aquaculture nutrition studies. The equipment will be useful in her work with the NCSU Eel Culture Project in Aurora, where she is developing diets to fatten eels and make them more nutritious.

A sea dog. It's not some edible delicacy made of seaweed or fish, but a two-person submersible craft designed to aid divers in underwater observation. And what's even more significant, the sea dog was designed by two high school students. Scott Trefethen and Donald Caison, students at E. A. Laney High School in Wilmington, wanted to build a submersible vessel that would allow divers to move faster and with greater ease underwater.

Sea Grant saw the project as an opportunity for the students to learn and develop research techniques. Through the North Carolina Student Academy of Science, Sea Grant provided funding for the Wilmington students and two other high school students to conduct marine science projects.

Sharon Briles, a student at Southwestern Randolph Senior High School in Asheboro, will receive a grant to study coral reefs and their relation to the marine ecosystem. She plans to set up a aquarium with coelenterates, organisms which form the coral reefs.

Another Southwestern Randolph High School student, Rachel Strickland, will be growing algae to use as a possible food source. Strickland plans to bake cookies made from her laboratory-grown algae.

Making Tracks, A guide to off-road driving at the coast is an illustrated pamphlet by Paul Hosier and Tom Eaton, two Sea Grant researchers who have been studying the effects of off-road driving on the environment of coastal North Carolina. The pamphlet lists sites open to off-road driving, points out local regulations, and suggests ways drivers can protect plants and wildlife. For a free copy, write to UNC Sea Grant, Box 5001, Raleigh, N.C. 27650. Ask for UNC-SG-79-06.

A Study of Federal and State Legislation Concerning the Construction of Proposed Oil Refineries, by Cy Grant and Thomas W. Earnhardt, is a study of federal and state regulations that would apply to two oil refineries proposed for Carteret and Brunswick counties. The paper points out potential deficiencies in the regulations and discusses possible solutions. For a copy, write UNC Sea Grant and ask for UNC-SG-WP-80-2. The price is $1 for out-of-state requests.

Continued on next page

Two UNC Sea Grant publications have won awards in international competition conducted by the Society for Technical Communication.

Atlas of Colonial Waterbirds of North Carolina Estuaries, by James F. Parnell and Robert F. Soots, Jr., won an achievement award. The atlas is a study of birds like the egret, heron and tern, and includes numerous photographs and charts describing their nesting grounds. (For a copy, write UNC Sea Grant and ask for UNC-SG-78-10. The cost is $7 for each request.)

How to Hang a Gill Net, by Jim Bahen and Mary Day Mordecai, also won an achievement award. The illustrated booklet gives step-by-step instructions for hanging a typical gill net. (For a free copy, write UNC Sea Grant and ask for UNC-SG-79-03.)

Six other UNC Sea Grant publications, including *Coastwatch*, won awards in competition conducted by the society's North Carolina chapter.

From the viral contamination of oysters to the impact of off-road vehicles on beaches, Sea Grant research spans a wide range of coastal concerns. Looking to the future, Sea Grant conducts research that anticipates tomorrow's problems. If you are a coastal citizen and see a need for answers to a growing or upcoming problem, let us know. Contact your nearest Sea Grant marine advisory agent—Dennis Regan or Hughes Tillett, Roanoke Island Marine Resource Center, 473-3937; Bob Hines, Bogue Banks Marine Resource Center, 726-0125; Jim Bahen, Ft. Fisher Marine Resource Center, 458-5498—or the Sea Grant office in Raleigh (737-2454).

If you are a researcher interested in conducting a project, contact B. J. Copeland or Bill Rickards in Raleigh (737-2454) with your ideas. Keep in mind the deadline for completed proposals is May 9.

In addition to the major research grants given each year, Sea Grant also awards mini-grants for short-term projects that seek to provide fast answers to immediate problems. Three mini-grants have been awarded.

Jim Easley, an associate professor of economics and business of N.C. State University, (NCSU), was given a mini-grant to study the economics of a shellfish transfer system in Brunswick County, which has had much of its shellfish-harvesting waters closed because of pollution. Shellfish can be transferred from polluted to clean waters where the shellfish will cleanse themselves of bacteria and viral contaminants. Easley wants to find out if the increased handling of shellfish would cut down on the fisherman's profits.

In another mini-grant, Ernie Seneca, an NCSU botanist and soil scientist, along with graduate student Ed Mrozek, will study how the toxic chemicals, PCBs, affect North Carolina marshes. Seneca wants to find the rate marsh plants take up the chemicals and how long they retain them. He also wants to know what happens to the creatures who feed on the contaminated grass and how far in the eco-system the PCBs are transferred.

Frank Thomas, an extension seafood specialist at NCSU, and Sam Thomas, a seafood specialist at the NCSU Seafood Laboratory in Morehead City, will be updating their manual for seafood processing as part of another mini-grant.

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COASTWATCH

Photo by Jim Erickson

Cyclist and shadow pedal in harmony along coastal North Carolina

A pedal-powered excursion to sun, sand and scenery

By Kathy Hart

From my left, the ocean crashes against the sand. From my right a bird wails in the marsh. Ahead of me, a flat, two-lane highway weaves between the sandy dunes and the grassy marsh. On my face are the spring sun and gusts of ocean air. Beneath me is my bicycle. I am bicycling through the Pea Island Wildlife Refuge, caught up in the scenery, my own thoughts and the cadence of my pedaling. I'm glad I'm not in a car.

Before today, I had never spent more than hour at a time on a bike. But now, I'm touring the Outer Banks along N.C. 12 from the Herbert C. Bonner Bridge to Buxton, 40 miles.

The first few miles were spent finding a good, steady pace that kept us together, getting into a gear that gave us the right combination of pedaling and gliding, and adjusting to a steady stream of traffic.

We stopped soon to adjust our seats and handlebars. We had brought along an array of tools, including enough bug repellent to ward off an army of skeeters. Right away the first scouting party was taking taste samples from my arms and legs.

As we pedal through the refuge, I shout to my friends, as an egret rises

Continued on next page

from the marsh, looking like a flake of snow against the blue sky. A mile or so farther, a pair of gray-brown ducks glide along a marsh pond in seemingly effortless motion. Nearby, some red cedars become animated after a flock of birds fill their branches with motion and sound. I cycle on.

At spots on the refuge, I can see clear across Hatteras Island, from the beach dunes to Pamlico Sound, about a quarter of a mile. The ocean has only to surmount an eight-foot dune and sidle across the marsh for the two waters to meet. That's exactly what has happened, during big storms. I cycle on.

We stop for rest and a snack in Rodanthe. Upon dismounting from my bike, my knees wobble, unsure that they can support the weight of my body. I am quickly realizing those 30- and 40-minute spins around the neighborhood weren't enough conditioning for this trip.

Soon after our pit stop, we pass the Chicamacomico Coast Guard Station. Abandoned years ago, the buildings are weathered gray. Some of the coast's most daring shipwreck rescues where made by men stationed here. Area residents are raising money to restore the old station.

Once by Rodanthe, Waves and Salvo, we again leave the billboards, motels, and convenience stores behind as we enter the Cape Hatteras National Seashore. The gentle morning breeze now turns mean as it briskly whips by us, slowing our pace. No longer can we pedal, g-l-i-d-e, pedal, g-l-i-d-e. It's now just pedal, pedal, pedal . . . . After only a few miles, we must stop to rest and plan a strategy against the wind. We decide to stay close together in a single-file line, so the front rider can knock off some of the wind from those behind. We will take turns leading the caravan.

Our plan helps some, but every inch forward requires maximum effort. I tell myself, make it to the next telephone pole, the next, then the next . . .

Finally, I see the black candy-striped Cape Hatteras Lighthouse. Buxton is near and the last bit of adrenaline flows for the push into town. I use the old lighthouse to gauge my distance to Buxton, much as the navigators long ago used it to gauge their distance from the cape.

We arrive. Famished, we head for the nearest hamburger joint to quiet our growling bellies. We explore the lighthouse and the beach—on foot. The lighthouse stands haughtily at the dune's edge. The encroaching sea is threatening to topple the lighthouse, which has stood here for 110 years. On the beach, a few fishermen are still casting their lines in the late afternoon surf. They tell us today's catch has been poor. Beyond the fishermen, there is only sand, surf, dunes and solitude.

We splurge on a hearty seafood dinner, hoping the treat will appease our aching bodies. But I have serious doubts that anything can revive me for the return trip.

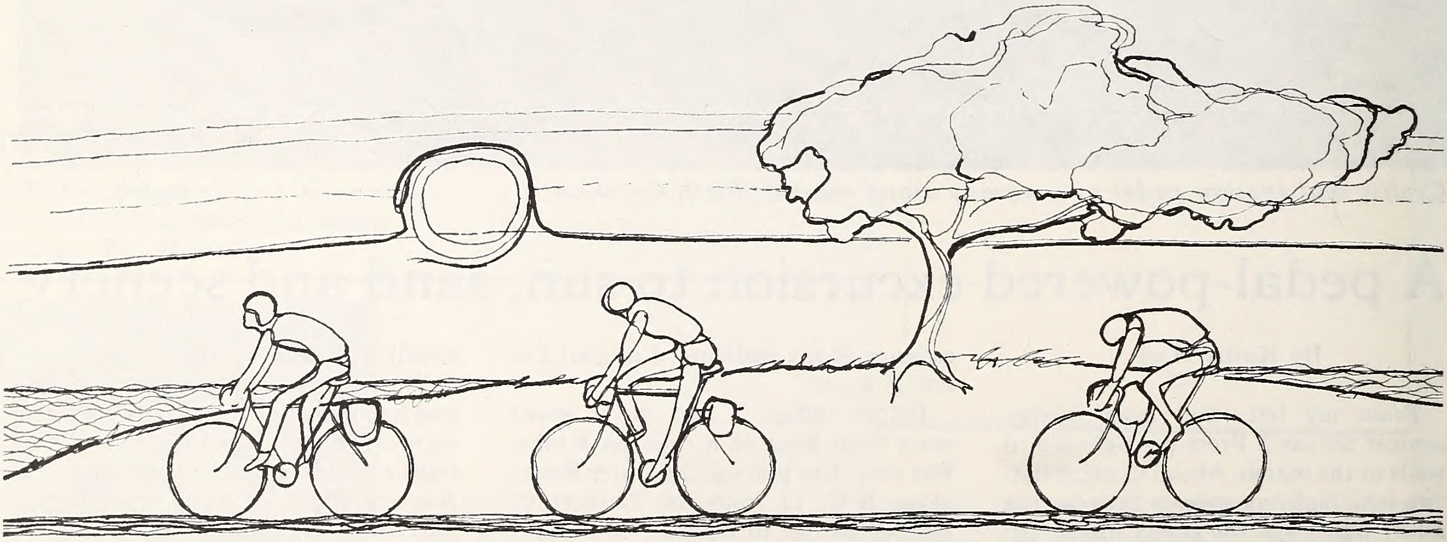
A night's sleep can do wonders. After breakfast and a stretching exercise or two, we whip out onto the road. The breeze is at our backs today and we glide along like sailboats over water. I'm ready to see the trip through.

The wind that confined us yesterday gives us freedom today. Sometimes I cycle ahead of my companions, other times I lag behind. I pull ahead at one point to take pictures as they pass.

Back on the road, I hear a car honk from behind. I move to the far right of the lane to allow a wide berth for passage. But my ears quickly tell me that this vehicle sounds very loud because it is too close. I move farther to the right and balance precariously on the edge of the road. Even then, the vehicle passes within a foot of me and my cycle. The bike waivers in the draft the car creates. Frightened, I fight to keep control of my bike, but my fright gives away to anger at the driver, who has nearly bullied me off the road.

We are in Salvo only an hour and a half after we left Buxton. It's hard to believe it took me three leg-numbing hours to cover the same distance yesterday. We snack and rest in

Illustration by Neil Caudle



Pedal, pedal, pedal against the wind

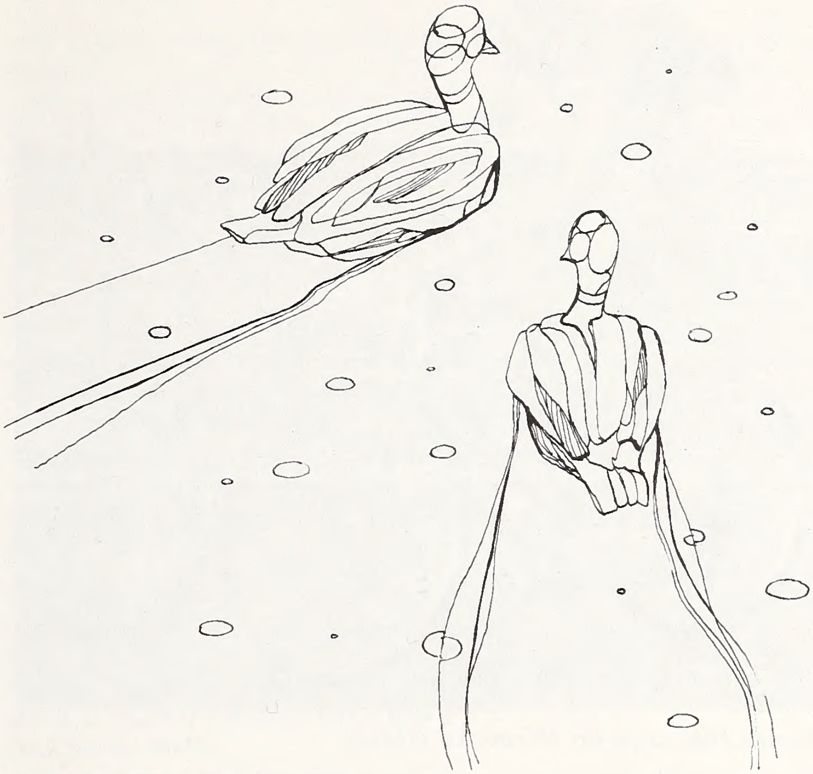
Rodanthe before our final leg back.

The clouds have been thickening all morning. On the air I smell the earthy odor of wet ground, only here in the marsh it has a saltier, fishy smell. The first drops of rain splatter my arms and legs. I decide not the bother with rain gear, since I'm only about eight miles from the car. Besides, the lukewarm raindrops feel good to my sunburned arms and legs. The rain must be keeping the marsh birds in the red cedars and wax myrtles today because I have seen little activity. Only a couple of ducks have waddled to a pond for a swim in the rain.

I am alone. My two friends have cycled ahead. I hope they wouldn't get the car and come after me. I want to make it all the way back. It is a matter of pride.

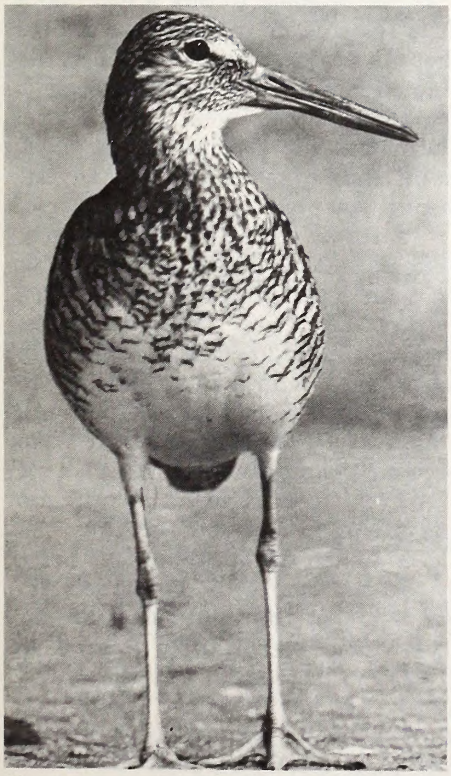
The arched span of the bridge looms just ahead as I wheel into the parking lot where we left the car. I made it. But more than that feeling of accomplishment, I keep thinking of that moment when I first felt the wind at my back and suddenly pedaling became effortless. This time the wind was taking me for a ride.

Illustration by Neil Caudle



Two ducks swimming in the rain

Photo by J. Foster Scott



You're more likely to hear this long-legged eastern willet than see him.

Ready to make your own trip?

Bicycling can be a good way to see, feel, hear and even smell coastal North Carolina. But before you head for your garage to dust off your bike, there are a few things you need to know.

- Spring and fall are the best seasons for biking at the coast. Roads are less traveled then and temperatures are moderate. If you want to travel this fall, it's not too early to start planning.
- Decide on a route. It's best to travel less-used, two-lane roads. (Remember that bicycles are prohibited from all interstate and limited access highways by law.) The N.C. Department of Transportation's Bicycle Program offers detailed maps for one coastal route and several inland routes. The coastal route winds through historic Edenton and Bath, to New Bern and along the coast from Swansboro to the South Carolina line. To contact the bicycle program write: N.C. Department of Transportation, Bicycle Program, P. O. Box 25201, Raleigh, NC 27611; or call, (919) 733-2804.
- Beware of the wind. Experienced bikers may find the wind challenging. Beginners should make their first trip with the wind at their backs. In the spring and summer, southeasterlies and southerlies prevail along the coast. Northerlies and northeasterlies become predominant by September. Keep in mind that morning winds are apt to be calm and light, but pick up velocity in the afternoon.
- Plan for rain. Mudguards and fenders will keep the wheels from splattering your back and feet with water and mud. A large rain cape, designed especially for bikers, will keep you and parts of your cycle dry. Be careful when it rains. Less traction between the wheel and the road can cause a fall. And, bike brakes, like car brakes, don't stop your cycle as quickly on wet surfaces.

Biking in the rain is one thing, but thunderstorms packing thunder,

Continued on next page

Photo by Clay Nolen

Pedaling against the wind on Ocracoke Island

Toe clips

Water bottle

lightning, high winds and heavy rains are a different matter. Get off the road and seek shelter during such a storm, if possible. Driving rains can decrease your own visibility, and that of motorists.

- Don't forget the sun. Protect yourself with lotions, clothing and hats. And remember, even on cloudy days, radiation can toast your skin.
- Think about where you'll sleep. For novice bikers, a soft bed feels awfully good to sore muscles. Also, you'll have easier pedaling if you're not carrying camping equipment. But once you've built up your muscles and your endurance, camping can enhance a biking experience. Camping areas are plentiful along the North Carolina coast. Check with the bicycle program or parks service to see what is available.
- Stash away a few snacks. Choose foods high in carbohydrates and potassium, such as bananas, pears or peanut butter. To quench your thirst along the way, carry a plastic bottle filled with water, weak tea or water laced with sugar. These bottles are handily attached to your frame.
- Get in shape. Begin to get yourself in condition at least 30 days before your trip. It's a good idea to check with your doctor before undertaking an exercise program, especially if you're over 30 or have a history of health problems. Do your conditioning gradually. Start out biking slowly, two or four miles several times a week, and build yourself up to a faster pace and longer distances. The bicycle program distributes a pamphlet, "Getting in Shape for Bicycle Touring," that offers a conditioning schedule and other advice.
- Check out your bike. Have your brake pads changed, the brake and gear cables checked, and your tires inflated to proper pressures. It's a good idea to have toe clips placed on your pedals. They keep your feet from sliding off your pedals and they allow you to pull up with one foot, while you're pushing down with the other. This can increase your biking efficiency 40 percent.

You don't have to have an elaborate touring bike to cycle at the coast. The flat terrain lends itself well to three-speed and single-speed bikes. But for long distances and varied terrain, a 10- or 15-speed touring bike is necessary.

If you're going to buy a bike, do a little research at the library and bike shops to see what type of bike best fits your needs. Also, be sure the cycle is the right size for your body frame. Good bikes are expensive these days, so be ready to make a sizeable investment if you plan to buy a new bicycle.

- Pack lightly. Take only necessities. You can buy bike bags or rig your own. Pack brightly colored clothes that are interchangeable. Bright colors are more visible to motorists. Roll your clothes to minimize wrinkling and place them in plastic bags to prevent them from becoming damp. Be sure to pack a set of bicycle tools. Carry a bike pump and tubing in case of a flat tire.
- Watch out for motorists. Some drivers are courteous, but others are not. Ride in the right lane and use those hand signals you learned in driver's education to indicate turns. Listen for approaching traffic and move as far to the right as possible as cars pass. North Carolina law treats bicycles like any other vehicles. Cyclists have the same rights and responsibilities as motorists.

Exploring the coastal backwaters by canoe

Cypress dripping with Spanish moss, a Venus' flytrap closing on a unsuspecting insect, a river otter sliding down a river bank... Nature has tucked away a lot of fine secrets along coastal North Carolina's rivers and streams. The best way to discover them? In a canoe.

"What I like best about canoeing is that feeling of isolation," says John Anema, an avid canoeist and a member of the Greenville Sierra Club. "You're away from everything. For me, it's therapy no doctor could ever provide.

"The quietness is great too. You make so little noise in a canoe that you blend in and animals hardly ever notice you. You see lots of wildlife that way."

Anema says one of his most exciting canoeing experiences came last month as he canoed Lake Mattaponni in Virginia. He saw two bald-eagles perched in a tree. "It was just a very majestic experience that I can't find the words to express," he says.

You might not see bald eagles in North Carolina, but you can see bobcats, river otter, muskrats, mink, deer, beaver, various waterfowl, alligators and snakes, most of which are nonpoisonous.

Cecil Frost, a ranger for the Merchant's Millpond State Park in Gates County, says the stories of snakes dropping from trees into canoes are exaggerated.

Frost says nonpoisonous water snakes do sun themselves in trees and bushes, and if startled, will drop. "But it's not like there are snakes hanging from every tree and bush," he says with a chuckle. "I've only had one to drop in my canoe in four years."

Poisonous water moccosins are not tree hangers, but instead, sun themselves coiled on logs in the river, Frost says. "What you have to remember is that most creatures are as scared of you as you are of them," he says.

If wildlife isn't your forte, then the coast abounds in unusual plant life. In the Croatan National Forest, you can find carnivorous plants such as Venus' flytraps, sundews and pitcher plants. Along the banks of Merchant's Millpond, you can see six species of rare wetland plants, such as water crowfoot and featherfoil, as well as more common plants, water lilies and swamp roses.

Most canoeists seem to agree that Merchant's Millpond is the most scenic area to canoe in coastal North Carolina. The 170-year-old millpond is surrounded by virgin cypress trees draped with Spanish moss. Canoes can be rented from the state park ranger for 75 cents an hour or $4 a day. A primitive camp on the millpond can be used for canoe camping. But, Frost warns, you must take everything you need in with you, and bring everything out.

The canoe trip through the pond is about five miles long. And, it's best to check with the state park ranger for a canoe route through the pond. Otherwise, you may get lost. If you're looking for a longer trip, you can canoe from the millpond down Bennett's Creek through the Chowan Swamp, about 20 miles. Frost says this is also a very scenic route.

Other good rivers for canoeing in eastern North Carolina are the White Oak River in Jones County, the Northeast Cape Fear and South Rivers in Pender County, the Black River in Bladen County and the Waccamaw River in Columbus and Brunswick Counties.

Moulton Avery, director of the Carolina Wilderness Institute, an organization specializing in wilderness training, suggests that beginning and less-skilled canoeists avoid canoeing in wide rivers or river mouths. "If you're canoeing in these areas and a wind blows up, it can cause a lot of wave action that can capsize your canoe," he says.

Also, many coastal rivers wind through remote areas and Avery suggests canoeists have some wilderness experience or training before attempting to canoe or camp.

Continued on next page

Photo by Carolina Wilderness Institute

Spanish moss drapes the cypress at Merchant's Millpond

Photo by Cecil Frost

Canoeists discover the solitude and beauty of Merchant's Millpond

As with bicycling, canoeists should plan their trips in advance. Avery says county maps, obtainable from the North Carolina Department of Transportation, are the best maps to use for planning a canoe trip. "These maps show where bridges are," he says. "Most canoe trips are oriented around bridges because they are easy access points to the river."

Frank Held of the Carolina Canoe Club, says canoeists should not be too ambitious when they estimate how far they can canoe. "A beginning canoeist can probably canoe eight miles a day, while a more experienced one can make about 12 miles," he says.

Canoeing can be a year-round activity. Frost suggests canoeing the Merchant's Millpond in May to early June, when many of the swamp flowers are blossoming, or in mid-October to early November when the cypress flame rusty orange and the red maples blaze.

"A river can look different every time you canoe it," says Dave Bennie, outing chairman for the Cape Fear Sierra Club. "When the water's high in the spring, a river runs faster and you can see over the bank, but in the summer when things start to dry up, the same river can be low in its bank and almost stagnant, like a swamp."

Many canoeists even enjoy winter canoeing. "Every time it snows I put my canoe in the water," Anema says. "The snow hanging in the trees and covering the bank gives the river a whole different look. It's elegant."

If you're interested in canoeing, you should learn some basic canoeing strokes and some water safety measures. The Carolina Wilderness Institute (P.O. Box 22102, Greensboro, N.C. 27420) and the Carolina Canoe Club (P.O. Box 9011, Greensboro, N.C. 27408) teach courses and seminars on canoeing techniques. The Sierra Clubs in Greenville and Wilmington offer regular coastal canoe trips along with some basic instruction. Also, the American Red Cross publishes a book about canoeing and canoe safety.

Held suggests a beginning canoeist always make his or her first trip with other experienced canoeists who know how and where to canoe. If you want to give canoeing a try, you can rent canoes from trail and canoe shops. But if you want to buy a canoe, plan to spend $250 to $1000, depending on quality and preference.

"Canoeing is increasing in popularity," Frost says. "It's the economical way to go. You can cover five or ten miles in a day, see lots of great sights and never worry about where the next gas pump is."

A few canoeing do's and don'ts can make your canoeing trip a lot safer and more enjoyable. Experienced canoeists say:

- Do wear a life jacket or other flotation device at all times.
- Don't overload your canoe. Two adults per canoe is plenty.
- Do carry a set of extra clothes wrapped in a plastic bag. You may need dry clothes if your canoe turns over.
- Don't canoe alone unless you're very experienced.
- Do map out a route for your trip and stick to it once you're on the water. It's easier to make a wrong turn on the river than it is on a highway, if you don't know where you're going.
- Don't canoe flooded rivers or streams. Hidden debris and strong currents can capsize your canoe.
- Do make canoeing a family activity. Canoeing is a good way for children to learn about nature. But plan shorter trips when you have children along.
- Don't brush against bushes or trees. Bees and hornets frequently make their homes there.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings and workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

It sounded like a tall tale: Some oysters in North Carolina were growing five inches in one year. Growth spurt, nothing—that's practically an explosion.

Fishermen had noticed for years that oysters in Slash Creek near Cape Hatteras were the biggest oysters around. The stories puzzled Hughes Tillett, a Sea Grant marine advisory agent in Manteo. Tillett found some oyster spat, babies not much bigger than BBs, and set them out in trays in Slash Creek. Boom. The oysters grew so fast that Tillett had to struggle to keep them from smothering each other. The average oyster takes about two years to get big enough for harvesting. Tillett's oysters were that large in one year.

What was Slash Creek doing for those oysters? Tillett packed up some samples and took them to Glenn Patterson, a biologist at the University of Maryland. Patterson was examining oysters for sterols, key substances (including cholesterol) that influence growth and other bodily activities.

Patterson found the same sterols in the Slash Creek oysters that he'd found in "normal" oysters up and down the East Coast. But there was one dramatic difference. The robust oysters had twice the amounts of each kind of sterol.

Patterson suspects that something in Slash Creek's food supply is chocking oysters full of sterols. And the sterols, he believes, may be behind the rapid growth.

Are the Slash Creek oysters freaks? Maybe, but Patterson offers another explanation. It's possible, he says, that widespread changes in the environment have all but wiped out some of the oyster's preferred foods, leaving only a few places, like Slash Creek, where an oyster can get a decent meal.

"Maybe the Slash Creek oysters are the normal ones," Patterson says. "The rest might just be a stunted version of what oysters used to be."

With more research, Patterson believes that scientists may learn how to give the typical oyster the same robust good health that Hughes Tillett's oysters found in Slash Creek.

UNC Sea Grant has received 39 proposals for research and education projects for the 1981-1982 funding cycle. The proposals are being reviewed to see which ones will be the most helpful in answering some existing or anticipated problems or needs. The proposals that are chosen as most promising will be included in the UNC Sea Grant proposal to the National Sea Grant Program office in Washington, D.C., for possible funding.

When fishermen hang their nets on shipwrecks, rocks or coral, they often lose more than just the time it takes to free their gear. Each "hang" can cost a fisherman thousands of dollars in torn nets and damaged equipment.

Hughes Tillett, one of Sea Grant's marine advisory agents in Manteo, has put together an updated version of an earlier Sea Grant publication, *Hangs and Obstructions to Trawl Fishing*, which Tillett also helped compile for North Carolina, South Carolina and Georgia. The new hang log covers the offshore waters of the entire Atlantic Coast of the U.S., and pinpoints the hangs using both Loran A and Loran C bearings. The book is designed to be used by professionals with Loran equipment.

In gathering information for the project, which was directed by James McGee of East Carolina University, Tillett interviewed trawl fishermen and combed their logs for records of hangs.

The new hang log, Tillett believes, will help save commercial fishermen thousands of dollars each year by giving them a more accurate "map" of hangs and obstructions.

Navigators can receive a copy of *Hangs and Obstructions to Trawl Fishing* by writing to Hughes Tillett, Marine Advisory Services, N. C. Marine Resources Center, P. O. Box 699, Manteo, N.C. 27954.

Last year's surf fishing class for youngsters was so popular that Jim Bahen, a Sea Grant advisory agent in the Wilmington area, will be holding several sessions again this year for girls and boys, ages 8 to 12. In the classes, Bahen will instruct his young students on how to do everything from baiting the hook to reeling in the fish.

The sessions will be held June 12, 17, 19, 24 and 26 at Wrightsville Beach. The morning classes will run from 8:30 a.m. until noon and the afternoon classes will last from 1:30 to 4:30 p.m. There will be ten students per session and registration is required.

Sponsored by UNC Sea Grant and a Wrightsville Beach sporting goods store, the sessions will end with a fishing tournament in which youngsters from all the classes can fish for prizes. For registration information, call the Sea Grant marine advisory services office at Ft. Fisher, 458-5498.

Bahen's not the only Sea Grant agent teaching folks how to cast a line,

Continued on next page

Dennis Regan, an advisory agent on Roanoke Island, is also teaching fishing classes each Wednesday from June 25 to August 7. Regan will demonstrate pier fishing from 9 to 11 a.m. in Nags Head, and from 2 to 4 p.m. he will teach surf fishing at the Marine Resources Center in Manteo. For more information, call 473-3937.

From the decks of the Crystal Dawn, about 50 people ooed, ahhed and clicked their cameras as they watched loggerhead turtles, hammerhead sharks, laughing gulls and a large school of bluefish. The occasion was a marine mammal and bird cruise, which embarked April 19 from Manteo. The cruise was organized by Dennis Regan, a Sea Grant marine advisory agent on Roanoke Island.

On board to help identify the mammals and birds sighted were Guy Oliver, a marine mammals expert, and David Lee, a bird and mammal specialist with the N.C. Museum of Natural History.

Everyone had hoped to spot whales on their annual trek from southern to northern waters, but the giant creatures didn't make an appearance. Instead, onlookers were entertained by a tern taking a leisurely ride on a loggerhead turtle, and by the playful antics of a school of porpoises.

Regan says he is planning a similar cruise for the fall.

Pound nets set in the sounds near Roanoke Island usually catch catfish, striped bass and shad, but this summer, one pound net will be catching people. Set up as a new exhibit at the N.C. Marine Resources Center on Roanoke Island, a 24-square-foot pound net has been hung so folks can walk into the net to see how it's made and how it works. Along with the net will be pictures and descriptions telling its history, how it's built and what it catches. Set up by Dale Martin and Hughes Tillet, the pound net is part of a larger exhibit funded by Sea Grant and the Office of Marine Affairs. The exhibit will explain the importance of net fishing in North Carolina.

Coastal Indians once shopped the marshes and swamps for seasonal wild plants that few people think of as edible: poke leaves, cattails, salt wort and prickly pear cactus. These were also some of the wild plants on the bill of fare during Wild Foods Weekend, held at the N.C. Marine Resources Center at Ft. Fisher, June 13, 14 and 15.

Wild foods experts taught participants how to identify, pick, prepare and eat some of the wild, edible foods found along the North Carolina coast. Sea Grant agent Jim Bahen showed one group of foragers how to catch a meal from the sea, while Bob Hines, the Sea Grant agent at Bogue Banks, taught participants how to catch, clean and prepare eels.

I want Coastwatch

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant. Box 5001, Raleigh, N.C. 27650.

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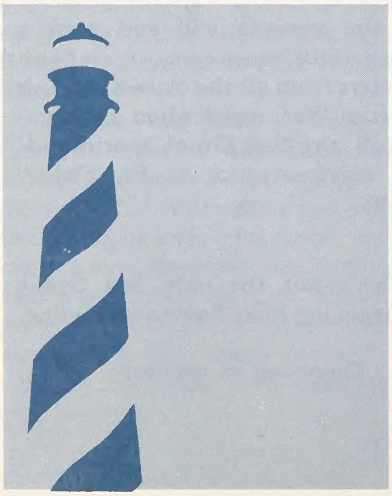

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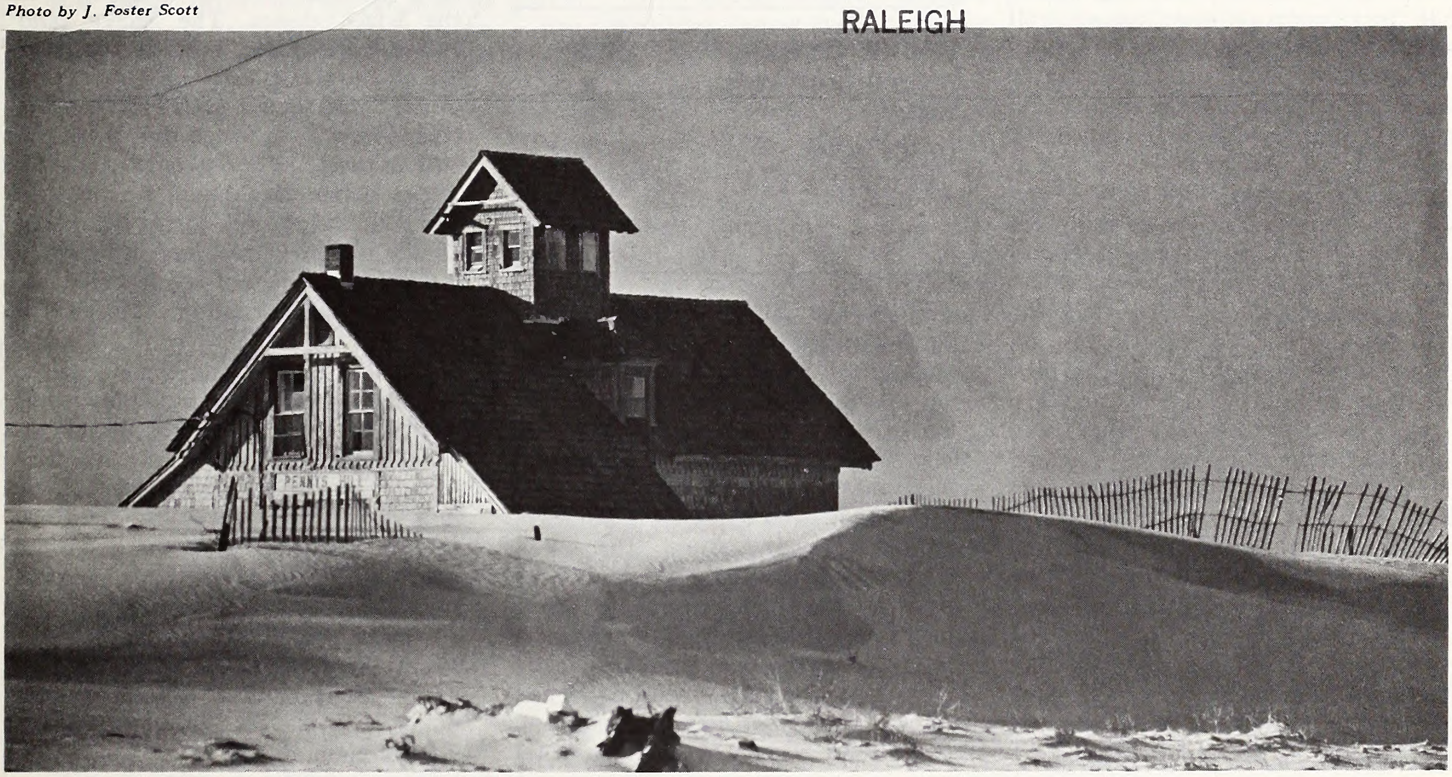


Bare, shifting dunes threaten the abandoned Pennys Hill Coast Guard Station

Dunes: Where the sea and the land mix it up

Sometimes North Carolina's coast seems like a battleground where people and regulations butt heads almost as regularly as the surf and shoreline. Many of the major skirmishes have been fought over dunes. Property owners have been denied building permits over them, off-road vehicles have been barred from them, and millions of dollars have been spent to maintain them.

What is a dune? It is a lot more than a pile of sand. Dunes store sand from the ocean, provide housing for ghost crabs, offer nesting grounds for loggerhead turtles and waterbirds, and serve as a last hold for beach grasses and sea oats. And, dunes are a flexible buffer between land and waves.

The clash between dunes and the ocean occurs along a line of scrimmage defended by the primary dunes. Primary dunes, the first large sand ridge back from the beach, are capable of holding off the waves of most storms. In front of the primary dunes are often smaller sand mounds called frontal dunes. These dunes offer less protection from the ocean.

Usually the interplay between the ocean and the dunes is equal. Each gives and takes a little. But occasionally, a team of waves and wind, often from a strong storm, comes along that breaks the defense, topples the dunes and rushes landward.

Sometimes, this defensive breakdown occurs because of holes in the dune line. People cut away at the dunes and its vegetation with their feet, their vehicles and their construction. These holes may allow the ocean to pierce the dune defense on the next high tide or during the next storm. The result can be flooding and erosion behind the dune line.

Continued on next page

Keeping an eye on this scrimmage is a referee—the Coastal Area Management Act (CAMA) and its enforcers. CAMA tries to lessen people's impact on the dunes in "ocean hazard areas" by regulating stabilization and construction near and on the dunes.

There would be little need for CAMA to referee, however, if people today would take a hint from earlier coastal settlers. They understood the dunes were changing, moving constantly westward like the sun. Then, people built on the backside or soundside of the barrier islands. And, if the ocean started creeping too close, they would put their houses on huge logs and roll them out of its path.

The dunes along the Outer Banks were smaller then, and the ocean often mounted their crests, surged landward and retreated, leaving large deposits of sand. But during the 1930's, the Civilian Conservation Corps stabilized the dunes in a large continuous mound of sand from Currituck to Ocracoke. Beach grasses and sand fences held the tall dunes in place. The ocean no longer overwashed the dunes and people began building closer to the sea.

But these man-made dunes may have hurt more than they have helped the Outer Banks' barrier islands, says East Carolina University geologist Stan Riggs. "Much of the Outer Banks are eroding from both sides now," he maintains. "The ocean can no longer overwash the dunes and build up the backside of the islands. At places like Rodanthe the estuarine erosion is as bad or worse than the ocean erosion. The barrier islands are becoming very skinny in places."

Riggs says the high barrier dunes may also be increasing beach erosion by making the beach narrower and steeper. They may allow the ocean to take larger bites of sand, especially during storms. But Riggs says he is not convinced of this "overwash" explanation of barrier island dynamics. Other scientists, also, question its validity. "We don't know as much about the dunes and barrier islands as we once thought we did," he says. "We need to do more research before coming up with any definite answers."

Taking root in windy sand
  is not an easy
way
to go about
  finding a place to stay.

from "Dunes" by A.R. Ammons

While the dunes may be a temporary defense for man and a replenisher for the barrier islands, the dunes are also a storage bin for sand. During storms, the ocean washes large amounts of sand from the beach and dunes out to sea. There, the sand forms ocean sand bars that lessen wave action. After the storm, the ocean gradually pushes these sand bars landward until the sand is again deposited on the beach. The sand particles dry in the sun, then are picked up by the wind for a ride down the beach. This ride may come to an abrupt halt when the sand particles meet a blade of beach grass or a sand fence head-on. The sand particles collect around the grasses or fence. The result can be a dune.

These ocean dunes are part of the beach-berm system that is built from the tug-of-war between the beach and the waves. But there are other types of dunes along our coast and they're not all on the beach.

Behind the beach dunes is a massive dune ridge that includes dunes like Jockey's Ridge, Pennys Hill and dunes on Shackleford Banks. The dunes have been formed from excess sand, Riggs says, that has blown and washed over the beach dunes. The excess sand comes from an old shoal system that lies off the North Carolina coast. Some of the dunes remain active and semiactive, Riggs says, which means they're still moving. "For instance, Jockey's Ridge is an active dune," he says. "It has little vegetation, so the wind continues to move the dune. It's not a change that you can see from day to day, but one that can be seen over the decades."

Behind this moving dune ridge is another series of dune hummocks that were formed during the last glacial age. It is on these dunes that the maritime forests have grown, Riggs says. These dunes and their forests are important to the barrier islands as collection points and storage areas for the only fresh water on the islands.

"There is a lot we still don't know about the dunes and a lot we have to learn," he says. "But, we do know the dunes are an integral part of the coastal community."

Beach grasses trap sand, rein in galloping dunes

If the dunes are so important to our beach system, then how can we make sure they'll always be there to protect us?

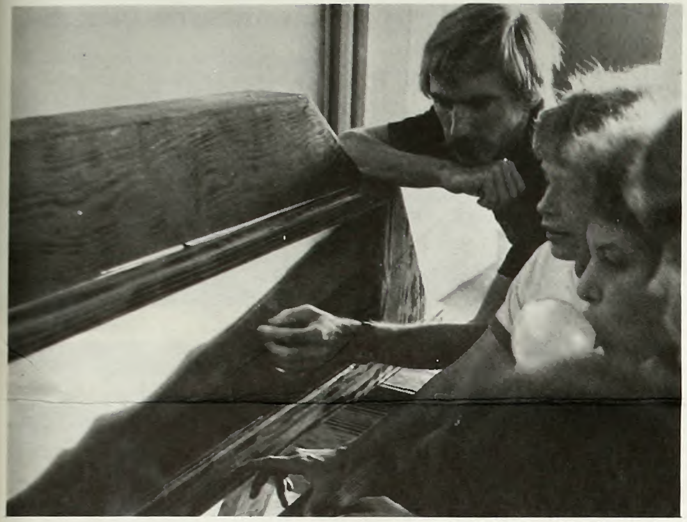
"The dunes are a mobile part of a mobile system," says Stan Riggs. "They're not a stable entity. The best way to protect them is to let them do their own thing."

The Coastal Resources Commission agrees that the dunes should be left to themselves, so they've developed some dune standards which provide the dunes some protection from man.

The Coastal Resources Commission enacted the following dune regulations:

- Landowners must build behind the crest of the large primary dune or the erosion setback line, whichever is farther landward.
- In building new dunes, a landowner must align the new dune with adjacent natural dunes.
- Existing dunes cannot be extended seaward unless they are extended naturally with vegetation or during an emergency.
- Sand used to build new dunes must come from outside the ocean hazard area.
- No dunes can be created in inlet hazard areas.
- Pedestrian crosswalks should not alter the dunes and should not be greater than six feet in width.

"It's time we started zoning and building structures that are designed to live with the changing environment," Riggs says, "instead of trying to make the environment change for us."



Beach dynamics

Using a wave tank at the N. C. Marine Resources Center at Ft. Fisher, Sea Grant coastal engineer Spencer Rogers can simulate the workings of the ocean, beach and dunes. The tank, which Rogers designed, gives a cross-sectional view of the ocean-berm system from the dunes to a few hundred feet offshore. By changing the turbulence in the tank, Rogers can demonstrate how different wave sizes can affect the beach and dune. For instance, during calm weather when waves are smaller, the beach is wide with a gradual incline toward the dunes. But during storms, when the waves are larger, the beach is narrow and steep.

In a small test area near Ft. Fisher, Rogers has anchored several old Christmas trees (left) to rebuild the dunes.

The National Park Service has adopted just that philosophy in its management of the man-made dunes along its Outer Banks national seashores. The park service has decided to abandon its upkeep of the high, man-made dunes.

Dunes built with bulldozers and dump trucks are costly. A simpler and less expensive way to build or restore them is to plant salt-resistant grasses. Planted in an area rich in sand-laden winds, beach grasses can collect a natural dune.

North Carolina State University soil scientist Steve Broome, a Sea Grant researcher, recommends three types of grasses for building dunes in North Carolina—American beachgrass, sea oats and bitter panicum. Why these grasses? They're tough. They can tolerate accumulating sand, wind gusts, salt spray, flooding, drought, the beaming beach sun and a meager food supply. But, they do have one weakness in their armor—they can't withstand being trampled by people and vehicles.

Beach grasses grow upward with the dune. Sometimes, during a storm, the ocean cuts away a slice of the dune and you can see the extensive network of roots and rhizomes that run through the dunes.

Broome says it is best to plant a combination of beach grasses. The American beachgrass, which makes a good dune starter, usually only survives a few years. Not native to North Carolina, the American beachgrass must have a constant supply of accumulating sand. It also falls easy prey to insects and disease. Sea oats are hardier, Broome says, but unlike the American beachgrass and bitter panicum, they can't be purchased at a nursery. Sea oats do not grow well under nursery conditions and must be dug from existing dunes. It's illegal in North Carolina, however, to dig up sea oats or cut-off their oat-like tassles. But Broome suggests that you find a neighbor who is willing to let you remove a few sea oat plantings or seeds from his or her property.

If you would like to know more about when, where and how to build or restore dunes, read the Sea Grant publication, *The Dune Book, How to Plant Grasses for Dune Stabilization*. For a free copy, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650. Ask for Sea Grant publication, UNC-SG-76-16.

But grasses aren't the only way to build a dune, just one of the more natural ways. Sea Grant coastal engineer Spencer Rogers says you can build a dune with sand fences, brush pilings and even old Christmas trees.

Once a dune is planted over with grasses, it's stronger. But no dune is permanent. A ferocious nor'easter or hurricane can erase dunes. "A lot of people along the coast have a false sense of security where the dunes are concerned," Riggs says. "They can't save you every time."

Caution: ORVs can be hazardous to a dune's health

So what happens to this thriving community of sand, grasses and wildlife when it's overrun by off-road vehicles (ORVs)? It's in trouble, according to Sea Grant researcher Paul Hosier of UNC-Wilmington.

Hosier, who has been studying the effects of ORVs on dunes for almost two years, has found that the same dunes that can hold off a pounding ocean cannot tolerate being trampled by feet and vehicles.

The first pass or two over the dunes by an ORV kills off the grasses and the sea oats by breaking the stems and exposing the roots to the sun, Hosier says. Voiding the dunes of vegetation not only keeps the dunes from growing, but also destroys the "fingers" that hold the dune together. The bare sand is prey to the wind and other vehicles.

"It takes the wind and the vehicle working together to create a large dune blowout," Hosier says. "When a vehicle traverses the dune, the first few passes disrupt the dune and move sand down slope. Following that, the wind removes more sand. The whole process is repeated when the next ORV passes. Before long, there's no dune left."

"I've seen four and five-foot dunes leveled by ORVs," he adds. "These are dunes that can't be duplicated without a gradual rebuilding process that may take years."

Leveling the dunes makes a hole in their defense for high tides and strong storms to come sweeping through. "It's like the Dutch boy taking his finger out of the dike," Hosier says.

Not only is it harmful to drive on the dunes, but it's destructive to drive along the dune base. Driving along the seaward foot of the dune destroys its growing edge by killing the beach grass that collects new sand. Hosier suggests that people who need to drive on the beach should stay on the wet sand area between the low and high tide marks. And, he adds, using designated access ramps to reach the beach will lessen the impact of ORVs on the dunes.

Hosier points to the Fort Fisher area in New Hanover County as an example of what unregulated ORV traffic can do. "There is no law enforcement there and people drive all over the dunes," he says. "The dunes are devastated; there is a 20 percent reduction in the vegetation; and so many crossovers have been made perpendicular to the beach that the next big northeaster or hurricane is going to cause a massive washover."

Fortunately, there aren't many sites as trampled as Fort Fisher. Many coastal communities have begun regulating ORV traffic. But the regulations have drawn controversy. ORV supporters say the regulations hurt local economies and unfairly limit the fisherman's access to the beach. Opponents say the vehicles damage dunes, plants and animals.

Hosier points out that ORV use along the North Carolina beaches has increased dramatically over the last ten years. In 1977 alone, 100,000 people drove the beaches of the Cape Hatteras National Seashore.

About 85 percent of the ORV drivers are fishermen, Hosier says. "But fishermen generally cross the dunes at prescribed crossovers, run up and down the beach to fish and then come back across the dunes at a crossover," he explains. "That's fine." Hosier thinks it's the people who "bust dunes" for fun that cause the most trouble. "They're why we need dune ordinances," he says.

Hosier says there are federal, state, county, municipal and private island ordinances in North Carolina that limit dune driving in one way or another. Some ordinances limit the time of year ORV operators can drive on the beach. Still others limit beach access to fishermen and some use a combination of limitations.

Sea Grant publishes a free pamphlet, *Making Tracks, A Guide to Off-Road Driving at the Beach*, which lists some of the dune regulations for beaches along the coast. The pamphlet also offers other ORV information. For a free copy, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650. Ask for Sea Grant publication 79-06.

Photo by Neil Caudle

An ORV rides over the crumbling dunes at Ft. Fisher

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

The point was to convince 24 teachers, most of them mountaineers and Piedmonters, that there's more to the North Carolina coast than beaches and sunbathing. Most of them got the message somewhere between the knee-deep trek through a salt marsh and the heave-ho as they hauled in an otter trawl full of sea urchins, blue crabs, shrimp, croaker, rays and sponges.

The teachers were part of a workshop conducted June 23-27 at Ft. Fisher by Lundie Mauldin, Sea Grant's marine education specialist. The coastal environment so intrigued the teachers that most of them are writing units on coastal studies into their fall lesson plans.

During the workshop, teachers identified plants and animals in the salt marsh with botanist Pat Ashton, fished aboard the *Cyclops* with biologist Gil Bane of the University of North Carolina at Wilmington (UNC-W), reviewed marine literature for children with Mary Wasson of UNC-W, toured historic Southport and Brunswick Town with anthropologists Tom Loftfield and Jim Sabella of UNC-W, and discussed coastal development and barrier island dynamics with Spencer Rogers, Sea Grant's coastal engineering specialist.

There were other highlights, but one event was clearly the most savored: a seafood dinner of fresh fish and shellfish donated by the A. C. McGirt Seafood Company of Carolina Beach.

Crab lovers know that good eating comes two ways—in a hard shell and a soft shell. But Collington crabber Murray Bridges knows a third version. Bridges has found that "papershell" crabs are similar in flavor and texture to the soft shell crab.

Soft crabs are crabs that have just shedded their shells. After about five hours, the crab's new shell begins to harden slightly and the crab is a papershell. After removing the papershell crab's legs and thin shell, the crab can be fryed in a light batter and eaten just like the soft shell crab.

Right now, only crabbers know about the papershells and how good they taste, Bridges says. In fact, many crabbers have had to throw the papershells in their catches away, for lack of a market. But Sea Grant advisory agent Hughes Tillett of Manteo and seafood specialist Sam Thomas of the NCSU Seafood Laboratory in Morehead City are trying to help Bridges spread the word about the papershell. Thomas is asking restaurant owners in Morehead City to put the papershell crab on their menus.

If all goes as planned, the papershell crab will begin to take its place on the plates of seafood lovers.

The National Marine Fisheries Service (NMFS) wants to know more about big game fish such as marlin, swordfish and sailfish: Where do they winter? How far do they migrate? What are their numbers? To find the answers, the NMFS is asking fishermen and longerliners to tag the fish they catch and plan to release. That way, if a fish is caught again, scientists will know how far it has travelled, its weight gain and other vital statistics.

If you catch a fish that has already been tagged, send the tag to the address stamped on the tag, along with information about the approximate weight and length of the fish.

If you're interested in tagging your catch, contact either Dennis Regan at the Marine Resources Center on Roanoke Island or Jim Bahen at the Marine Resources Center at Ft. Fisher.

Commercial fishermen trawling for croaker, trout, bass and porgies have found one serious limitation to conventional trawl nets: they can only fish along the bottom. When the fish rise into mid-water, as they often do during the day, standard gear is ineffective.

Foreign fleets have solved the problem with mid-water nets, which are designed to ply almost any depth. American fleets have been slow to use the new gear.

But two fishermen from Wanchese, Kenny Daniels and Will Etheridge, are giving the system a try.

Daniels and Etheridge learned about the net through Hughes Tillett, Sea Grant's marine advisory agent stationed on Roanoke Island. Fishermen from the Wanchese area had also attended a Sea Grant workshop on mid-water trawls, conducted in Manteo during June. The fishermen were impressed by what they heard, but wanted to know more before they plunked down thousands of dollars on new gear.

So Tillett helped Daniels and Etheridge arrange a trip to Nova Scotia to see some mid-water trawl equipment firsthand. Both men bought nets, and will put them to work this summer. In return for Tillett's help, Daniels and Etheridge will keep track of the net's performance and report to Tillett, who will pass the information on to other interested fishermen.

Continued on next page

What do birds, folklore, underwater archaeology and hurricanes have in common? They're all topics for a summer-long series of talks about the Outer Banks of North Carolina.

Dennis Regan, a Sea Grant marine advisory agent on Roanoke Island, has organized the discussions, which will be at the Nags Head Cove Clubhouse at 8 p.m. each Thursday until the end of August.

Discussion leaders and topics are:

July 24—Robert Needham on summer birding on the Outer Banks
July 31—Virginia Ross on legends and folklore of the Outer Banks
Aug. 7—Lt. John Leslie on the historical background and current responsibilities of the Coast Guard on the Outer Banks
Aug. 14—Gordon Watts on underwater archaeology and Monitor research
Aug. 21—Dr. Jerry Machemehl on the effects of coastal hurricanes
Aug. 28—Spencer Rogers on a homeowner's guide to hurricane-proof construction

Two graduate students have received Sea Grant fellowships to further their studies in marine science.

Richard Miller, one of the recipients, will be starting his work toward a Ph.D. in the field of marine science and engineering at North Carolina State University this fall. Miller received his bachelor of science degree in zoology from Duke University and his masters degree in marine science and applied statistics from Louisiana State University.

Jurij Homziak will be working toward his Ph.D. in the Curriculum in Marine Science at the University of North Carolina at Chapel Hill. Homziak received his undergraduate and masters degree from San Diego State University in the fields of zoology and biology, respectively.

Before January 30 of this year, a boat's "head" (or toilet, to landlubbers) could legally discharge directly into the ocean. Now, the law requires that boats operating within three miles of shore be equipped with sanitizing gear or onboard holding tanks—expensive items, especially for recreational boaters.

Sea Grant coastal engineer Spencer Rogers has devised a low-cost portable holding tank for use on smaller boats that can be attached to an existing head. Designed for light use, the tank can be carried home and emptied at the end of the day. The portable tank is made from a five-gallon collapsible jug that can be purchased from camping or auto supply stores.

For detailed instructions on how to make and install the tank, write Spencer Rogers, Marine Advisory Service, N.C. Marine Resources Center/Ft. Fisher, Kure Beach, N.C. 28449.

I want Coastwatch

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant. Box 5001, Raleigh, N.C. 27650.

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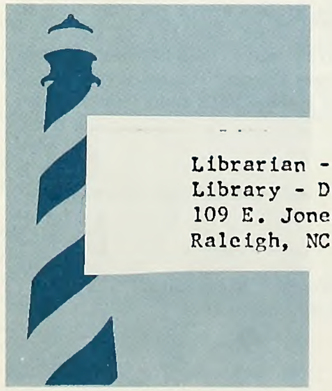

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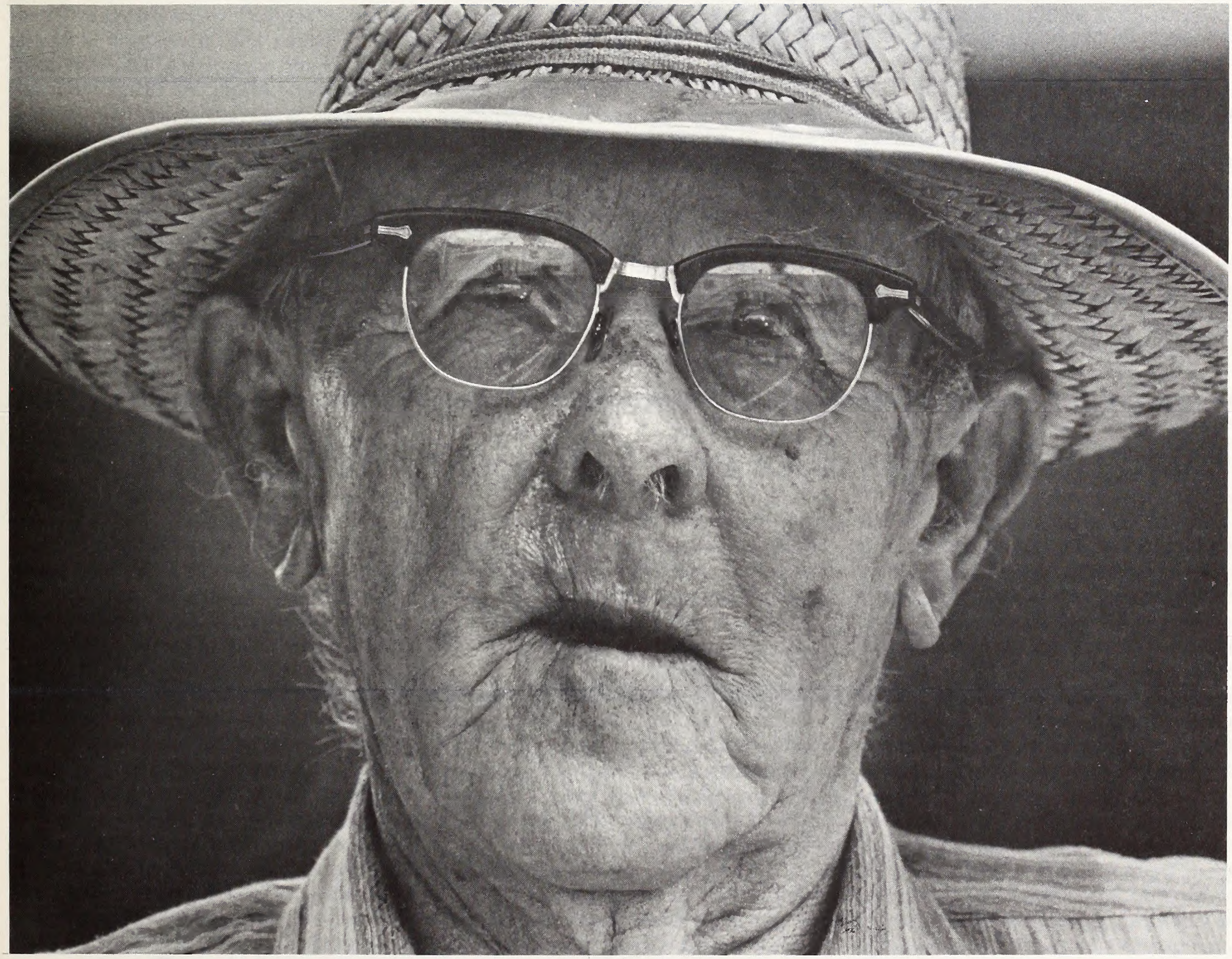


"Things just don't hold a straight line," says Harkers Islander Irvin Guthrie

Storm carved an inlet And broke island's sleep

One evening in September, 1933, Irvin Guthrie walked out of his house and felt water rising around his ankles. A huge storm, one of those nameless but historic hurricanes, was shoving water up in Back Sound, flooding Harkers Island.

"Up in the road, somebody had a lamp lit," Guthrie

Continued on next page

recalls. "People were tying themselves together with a long rope, so nobody would get lost. They were headed for high ground."

Guthrie joined the group for a moment, but left it when he suddenly felt drawn away for what might have been his last glimpse of the house he'd grown up in, his father's house.

"Just when I got back down there, that's when the water broke open Barden Inlet. Then it stopped rising and started dropping down."

It was as if a dam had burst. The swollen sound had split the land barrier and carved a new inlet between Cape Lookout and Shackleford Banks.

Harkers Island was spared, and its people untied themselves and went home to what was left of their houses. The hurricane had swept Guthrie's house off its foundation, but set it down whole. His neighbors helped him lift it back astride its underpinnings.

"Only thing is, the doors and windows never fit just right after that," Guthrie says. "Things just don't hold a straight line."

For Guthrie, that September night was a turning point in the life of Harkers Island. It was, he says, almost as if when the water rushed out, the twentieth century rushed in. The inlet made it easy for sports fishermen and tourists to use the island as a jumping-off place, and brought about more change, Guthrie believes, than the bridge, which was built in 1941.

"It was the worst thing that ever happened," Guthrie says about the inlet. But he hasn't always felt that way. "I was one of the first that went to the government and asked them to dig it out," he says. "We thought it was going to make it easier to get in and out. And it did, but everybody else started using it, too. And each year it gets a little wider, and now it's about to take the lighthouse with it. If we'd just left it alone, that inlet would have long ago filled in."

Along with the boats came a steady flow of sand and saltier seawater, which changed almost overnight the fishing in Back Sound.

"There used to be an oyster rock yonder, where there was always a mess of oysters," Guthrie says. "But since that inlet broke open, and the sand came washing through there, you can't do any good there."

Clams, oysters and scallops were plentiful in the sound before the storm. Shrimp were so thick in the water that they fouled nets and made enemies of the fishermen, who called them "bugs." Mullet swam in schools that Guthrie says would have covered a half acre.

"When I was born here in nineteen-o-one, there were less than a hundred people living here," he says, "and everybody at the time made a living out of salt water."

In his house, there is an automatic clothes washer. There is also a television. Down the street are a movie theater and a new bank. But the house is the same house, his father's house.

"This is an old house and an old style," he says, rocking on his porch. A stiff breeze off the sound makes 90 degrees feel like 75. "But I wouldn't trade it for any mansion on the road. Every morning I get up and see my own kingdom here. . ." His hand sweeps out toward the sound, hovering like a gull in the wind: ". . . the water."

Fishermen keep nets and traditions well-tended

If you take the road to Harkers Island, you won't find anything exotic or even especially scenic through your car windows. From the road, it is another pleasant Down East community. There are 667 houses. Of these, 549 are used all year. Half are plain, frame cottages and the rest are about equally divided in number between brick houses and mobile homes. The island, low, flat, and tree-shaded, is stretched out in the waters of Back Sound, sheltered from the Atlantic by the jutting elbow of land formed by Cape Lookout and Shackleford Banks.

"If you go to Harkers Island with the notion that you're going to find this quaint, old-timey fishing village, forget it. It's just not there," says Jim Sabella, a Sea Grant researcher and an anthropologist at the University of North Carolina at Wilmington. "It's only when you've lived there for a while, and you get to know the families, that you see the older way of life coming through."

It is a way of life that lures young people, especially daughters, home from the cities, and one that attracts well-to-do outsiders into rustic retirements spent among boats, nets and porch swings. In 1900, there were fewer than 100 people living on the island. Now, there are 1651.

Fishing is not the whole of life on Harkers Island, but it's the foundation. And it's the starting point for Sabella and his research associate, Marcus Hepburn, when they talk about their two-year, Sea Grant study of the island.

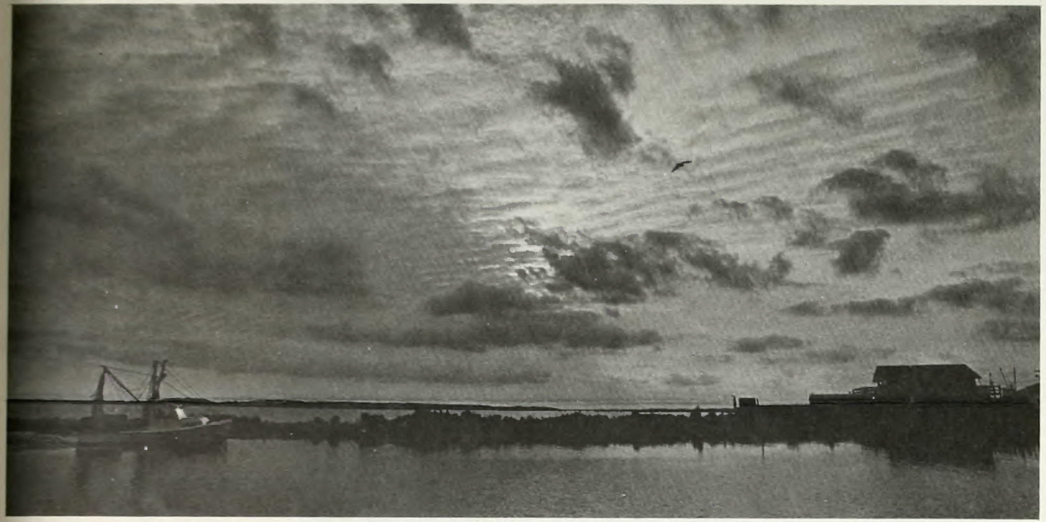
Sabella and Hepburn wanted to be able to tell the agencies charged with regulating the state's fisheries something about the people they are regulating—their values, their history and their culture. But Sabella and Hepburn also wanted to know what's likely to be left of places like Harkers Island when the twentieth century gets through with them. Harkers Island was singled out for the study, Sabella says, because it is fairly representative of the state's fishing communities.

"There, in a relatively small space, we could look at many different types of fishing and many different sizes and types of fishing craft," Sabella says. "The same kinds of fishing are done in other parts of North Carolina, but not all of them in the same place."

Sabella's research associate, Marcus Hepburn, lived on the island for 21 months, made over a hundred fishing trips (for what he terms "participant observation"), and talked with almost every family that's called the island home for a generation or more. During those months of fishing, visiting and careful interviewing, Hepburn began to uncover a side of Harkers Island the tourists don't see. The only way to come to know the island, he believes, is to come to know it in the same way its people have: by way of the water.

So Hepburn climbed aboard the boats and went fishing. The great variety of gear and techniques astounded him. There are 143 commercial fishermen on Harkers Island. Fewer

Photo by Steve Murray



A commercial fishing boat leaves the island at dawn

than half of these fish full time; the rest piece together incomes from boatbuilding or outside jobs. But though they are few in number, these fishermen are exceedingly diverse in the ways they work. They trawl, dredge, net, rake, kick, hook and tong almost everything that swims in the salt.

One of their most striking qualities, Hepburn says, is their inventiveness. Harkers Island fishermen developed, apparently independently of other regions, a way of catching shrimp: channel-netting. Harkers Islanders began making channel nets in the 1930s, and the gear was almost unknown elsewhere along the East Coast until recently, when its fuel-saving advantages made it attractive to fishermen to the south. A channel net looks something like a trawl, but it is anchored in place in or near a channel with a good tidal current and is fished at ebb tide, when the currents sometimes carry shrimp in swarms. Once the net is set, a fishermen positions his boat over the net, shuts down his engine, and empties a tail bag full of shrimp every 20 minutes or so.

"One night I was aboard with a fisherman when he harvested a thousand pounds of shrimp in five hours," Hepburn recalls. "His total gas cost was about two dollars."

Big trawlers often catch more shrimp, but they can burn hundreds of gallons of fuel, at well over a dollar a gallon.

There are 22 or 23 good channel net locations around Harkers Island but a spot called "Gold Mine," in the "straits" between the island and the mainland, is considered to be the best. The islanders have developed a rigorous set of unwritten laws governing prime spots like Gold Mine. To establish his right to channel net in a popular location, a fisherman must first "lay on a set." For example, if James is fishing Gold Mine and Doug wants some of the action, then Doug must line up his fishing boat and wait with gear aboard, directly behind James. When James hauls out, after maybe four or five hours of fishing, he must yield to Doug. Doug may spend a day and most of a night laying on a set, or he may pay a young person to man the boat for him.

But it's not just channel netting that brings out the islanders' skill at self-regulation. There are equally effective and time-honored rules governing long-line and long-haul fishing. The captains of long-haul crews meet informally at the beginning of each season and list the best fishing locations. They assign a sequence that allows the crews to rotate through all the spots, so that each crew holds the rights to an area each day of the season, except Sundays.

Perhaps partly because they have been so successful governing themselves, the fishermen of Harkers Island view governmental agencies of all kinds with suspicion. Responding to a survey that asked who they thought had the most influence on fisheries policy-making, the Harkers Island fishermen placed commercial fishermen last among five groups. Fisheries officials, however, said that they weigh the fishermen's opinions higher than all other groups but one, the seafood dealers.

But fishermen and officials agreed on the best ways to publicize new policies. And, in some cases, Harkers Island fishermen have even begun to ask for more state regulation. Sixty percent of the commercial fishermen surveyed wanted the state to outlaw clam-kicking, which has been suspected of damaging shellfish nursery areas.

As Sabella points out, many of the new problems facing fishermen—competition from outsiders, fuel costs, pollution and scarce supplies of some species—are beyond the fishermen's abilities to control.

"I think the North Carolina Division of Marine Fisheries has boosted tremendously its credibility among Down East fishermen," Sabella says. "They've done so by getting out and asking the fishermen what they think."

Continued on next page

One of the fishermen they ask is Ben Brooks, a Harkers Island native and graduate of East Carolina University. Brooks gave up a teaching career to devote himself to commercial fishing on the island. Brooks believes that his way of life is in serious trouble, largely because of the scramble for new gear, bigger boats and bigger catches.

"You have to go harder to make a living," he says. "You have less leisure time. You could have a certain trawl this year, catching shrimp, and next year somebody could pop up a new idea, and the following year, you'll probably have to get a new trawl."

It is the small-scale commercial fishing operation that is going to be weeded out, Brooks says.

"The shrimp are going to be protected there under the grass, moving north. And the man that's got some other source of income is protected, because whether he catches anything or not, he's going to get by. But the commercial man has to go right on through the hard times."

Marcus Hepburn sees a similarity in the evolution of farms into agribusinesses, and the new trend away from the kind of one-family fishing operations found on Harkers Island.

"The thing you have to ask yourself is, will we continue to have small fishing operations?" he says. "It could go the route of agriculture: bigger business units, bigger boats. And if that happens, the Harkers Island fishermen won't be able to adapt. They enjoy their independence and won't give it up."

But even if they lose their boats tomorrow, fishermen on Harkers Island won't line up for handouts.

"These people have a wide range of skills," Jim Sabella says. "A lot of them have built their own homes, in addition to their own boats. They do electrical work, they do mechanical work, they work with hydraulics. They are rich in abilities and intelligence, and they're perfectly capable of taking care of themselves."

But most of the island's fishermen are operating on the assumption that fishing has a future there. Even so, the pressures are giving some islanders pause to wonder. In a study of how fishermen's wives regard their lives and their husband's careers, Sabella and Hepburn found a reluctance on the part of the women to endorse fishing as a way of life for their children. Almost half of the wives surveyed were opposed to their sons becoming fishermen. But, as Sabella points out, "The women are very supportive of their husbands' occupations, in the sense that they realize that the men are happy on the water, that they are their own bosses, that nobody interferes with them, and that it's a good life."

The study also found that three-quarters of the women worried "considerably" or "very much" about their husbands' safety. Most wanted their husbands to restrict their fishing to day trips and to safer areas inside sounds and estuaries.

"The fishermen's wives almost universally said their lives were tougher than other wives'," Sabella says. "They think that fishing is not adequately rewarded, financially. But that still doesn't mean, when everything is said and done, that they wouldn't rather stay in the fishing."

Whatever the hardships, Harkers Island has an almost astonishing hold on its daughters. As Sabella puts it: "The women, if they can help it, stay on the island."

Joann Brooks, who was not raised on the island, but inherited the Harkers Island way of life when she married Ben Brooks, expresses her regard for the island this way: "The people are different here," she says. "There's just a closeness that you have over here that you don't have other places."

The August issue of Coastwatch *will look at Harkers Island's boatbuilders and social traditions.*

Photo by Steve Murray

Marcus Hepburn (left) visits with Mary and Dallas Rose in their house on Harkers Island

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

The rendezvous: October 6, 1980, on a remote stretch of beach near Duck, on North Carolina's Outer Banks. The team: hand-picked professionals from France, Japan, England, Canada, Nova Scotia, Norway and the U. S. Support: aircraft, ships and satellite communications. Code word: ARSLOE.

The plans for the Atlantic Remote-Sensing Land and Ocean Experiment sound something like those for an allied invasion. But the object is peaceable: to measure the height, length, shape, strength and frequency of ocean waves.

Knowledge of waves and wave energy is crucial to communities trying to deal with pollution, coastal construction, shoreline erosion and other coastal problems. But very few reliable data are available to help planners predict what sort of waves can be expected for various periods or weather conditions.

ARSLOE will be the first project in which so many wave-energy specialists from such diverse backgrounds have focused their equipment and their attentions on the same stretch of shoreline. The site at Duck was chosen because of the relatively uniform topography of the ocean bottom there, which will make comparing data easier, and because the U. S. Army Corps of Engineers' pier there is well-outfitted for coastal research.

The Corps' Coastal Engineering Research Center is coordinating the experiment, and the data collected will be sent to the National Oceanic and Atmospheric Administration for analysis.

Two teams of Sea Grant researchers, headed by Ernie Knowles and Tom Curtin of North Carolina State University, have been invited to take part in the experiments. In his Sea Grant work, Knowles is investigating ways to predict ocean waves. Curtin's Sea Grant project is designed to develop new instruments for studying near-shore currents and other physical processes.

In all, about 25 devices, built to measure everything from gentle swells to crashing breakers, will be riding the waves during the two-month term of the experiment. When the findings are in, scientists will be better-equipped to select the best methods and instruments for their studies of waves and currents.

Howard Kerby wants to make sure that the state's fishermen can continue to land lunker bass. So, he is doing research in how to freeze them—not the striped bass, but their sperm.

A Sea Grant researcher from North Carolina State University, Kerby has been working toward freezing and then hatching large quantities of striped bass sperm on a production basis. In 1978, the first results from the freezing process showed there was no significant difference between fish produced from fresh sperm and those produced from frozen sperm. In normal artificial fertilization techniques, the success rate is usually 60 to 80 percent. But when Kerby's frozen bass sperm were mixed with the fish eggs, the rate was figured as high as 88 percent.

The major research involved in the project included testing cryoprotectants (which protect cells during freezing) and extenders with the sperm under controlled rates of freezing temperatures. Kerby says that the frozen sperm he has produced will last up to hybrid sperm will last up to two years. He sees the frozen sperm being most beneficial to hatcheries hard-pressed for enough males to fertilize eggs and to other parts of the country where striper males are scarce. His research, Kerby explains, could result in more fish in the lakes and reservoirs and more fish stocked in estuaries with population problems.

They sold for seven cents a pound in 1880. Fishermen threw them away when the ugly, spiny crustaceans became hung in nets. Of those that sold, about half were used as fertilizer and bait. The crustacean? Shrimp.

John Maiolo and John Bort, Sea Grant researchers at East Carolina University, are gathering some historical information on shrimping in North Carolina as part of a sociological study on the shrimping industry. They have uncovered some interesting facts.

In the late 1800s and early 1900s, shrimping in North Carolina was confined to the southern coastal counties of New Hanover and Brunswick. Fishermen used seines, cast nets and skimnets to catch shrimp in shallow sound bottoms.

Between 1915 and 1920, some changes came along in the industry that spurred fishermen to become more interested in catching the crustaceans. Two shrimp canneries opened in Brunswick County, fish houses began shipping shrimp out of the state to markets in New York City, and the otter trawl was introduced in the state. The otter trawl allowed fishermen to drastically increase their catches because they could fish deeper waters offshore.

Continued on next page

During the 1920s and 1930s, shrimpers began plying the waters of the Pamlico Sound for the first time. This opened one of the richest shrimping grounds in the state. After World War II, shrimp became more important and the industry boomed in North Carolina and throughout the South Atlantic states. More fishermen began fishing shrimp as prices the shrimp brought began to soar. Today, the shrimp fishery is the most valuable fishery in the state, and there is an increasing need to know, not only about the biology of the shrimp, but about the people who fish, process and market it. Through interviews with fishermen, processors and marketers, Maiolo and Bort are trying to put together a complete sociological picture of North Carolina's shrimping industry. Such a picture will help officials formulate new strategies for managing the state's shrimp fishery—strategies based on a knowledge of the people being managed.

In the past, the staff of the North Carolina Marine Resources Center at Bogue Banks has often had to beg, borrow and swap for specimens to fill the center's aquariums. The center didn't have a boat large enough to capture all the marine life it needed, especially those species from off-shore waters.

But this summer, the center launched a new, 23-foot Sea Ox, especially modified for gathering specimens. The boat will be shared with the Marine Resources Center on Roanoke Island.

The modifications in the Sea Ox were made by Bob Hines, Sea Grant's marine advisory agent at Bogue Banks. Hines wired and mounted gauges, antennas, nets and radios, and put the boat in working order.

Says Dave Williams of the center's staff: "The boat will make it a lot easier for us to get the specimens we need, when we need them."

Would you like to serve crab meat panned in butter or crab casserole for dinner, but your pocketbook won't let you? If you have access to coastal estuaries—sounds, bays and river mouths, you can catch crabs at little cost with your own crab pot. UNC Sea Grant has a new publication, ***How to Build a Crab Pot***, that describes the making of a crab pot in ten illustrated steps. The booklet also describes the regulations that govern recreational crabbing in North Carolina. Another pamphlet, *Dipping and Picking*, published by South Carolina Sea Grant, describes how to cook, clean and pick your crabs once they're caught. For a copy of either publication, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650.

The Washing of Fish: A Literature Assessment, by Freda A. Ramey, Joyce A. Taylor and Frank B. Thomas, is a guide to articles and publications on the methods for washing fish commercially. The technical report reviews literature on techniques and equipment, as well as seafood handling, sanitation and preserving. It is designed to be of special value to the seafood industry. For a copy, send $1.00 to UNC Sea Grant and ask for publication UNC-SG-79-07.

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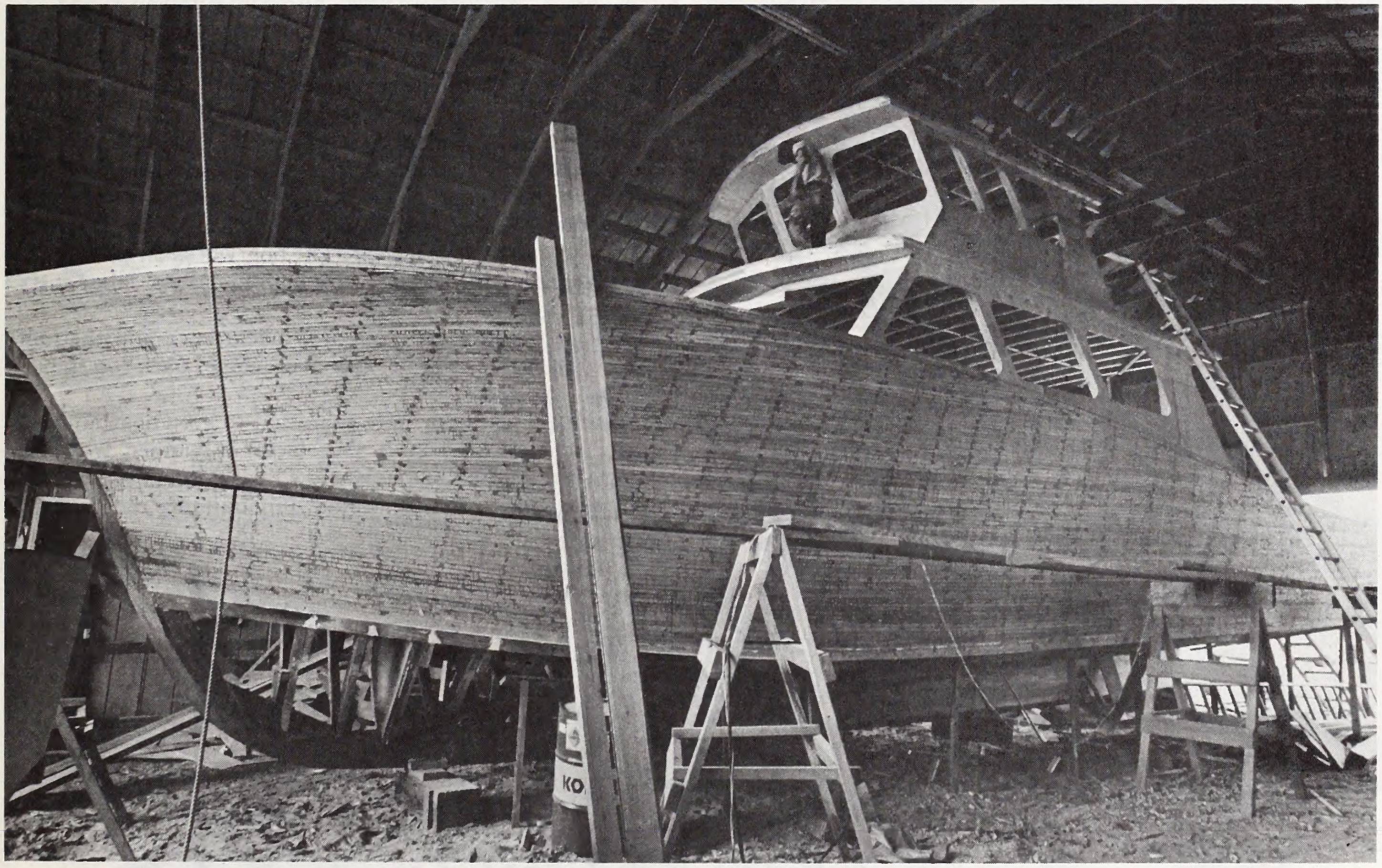


A Harkers Island builder works on the "flying bridge" of a sportfishing boat

Boats as seaworthy as the people who build them

When Ebeneezer Harker bought what was then called Craney Island in the mid-1700s, he listed his occupation as "boatwright." But if boatbuilding took root on the island with Harker, it lay sleeping until Brady Lewis started a small boat yard there in 1926.

The match was made, and boatbuilding spread like a virus. Some people swear it's long since been programmed into the genetic makeup of Harkers Island bloodlines. It was a natural match. Fishermen needed boats. The material was handy—strong, mannerly lumber cut from stands of Atlantic White Cedar (they call it "juniper") growing in the coastal swamps.

Boat yards sprouted and refused to die, even in the face of competition from big companies manufacturing boats of fiberglass and metal. There are today 41 people building boats on the island, mostly in their backyards, where their lumber is stacked lean-to-style and their table saws straddle mounds of juniper sawdust, a sawdust so aromatic it will

Continue on next page

practically knock a cold out of your head.

Earl Rose is a senior member of the branching family of boatbuilding Roses on Harkers Island. At 72, after 50 years of boatbuilding, during which he worked on more than a thousand boats, Rose has turned his shop over to a half-brother, Paul, and is building for his daughter what he says is his last craft, a 39-foot fishing boat in the classic Harkers Island style.

"It's your typical, Harkers Island commercial fishing boat," he says. "It's got a round transom on 'er, where you can pull a gill net over it, with fish in 'er. And I've got the flared bow in 'er, and I've got the deep vee in 'er, so she'll ride easy in a sea wave. Well, it's just a model that we've built for years, and you can't beat 'em. There ain't no way you can design one any better for the kind of work we do here."

Like most of the builders, Rose has spent about as much time fishing in boats as he has building them. He fished when the fishing was good, and built boats when it wasn't. What he learned about fishing found its way into refinements in his boats. The shape of a seaworthy craft became lodged as permanently in his mind as a ship in bottle. Harkers Island boatbuilders construct work boats from their heads, not from blueprints. The only drawings you find them using are a few casual pencil-scratchings on scrap lumber.

"The length, the width, the depth, all of that, it's in your mind," Rose says. "You make your keel and you cut your frame and you go to puttin' together and puttin' together and puttin' together, until you get 'er finished, and she comes out a nice-looking boat."

Rose, like other builders on the island, has made his share of sport boats—charter craft, yachts and sports fishing boats. Once, he says, there was all the business the builders could handle. Not so this year. The boatworks on the island, Rose says, are being squeezed by high fuel costs, labor costs and interest rates.

"Now, if the interest rates drop back down and the fuel drops back some, the bloom will come back on boatbuilding," he says.

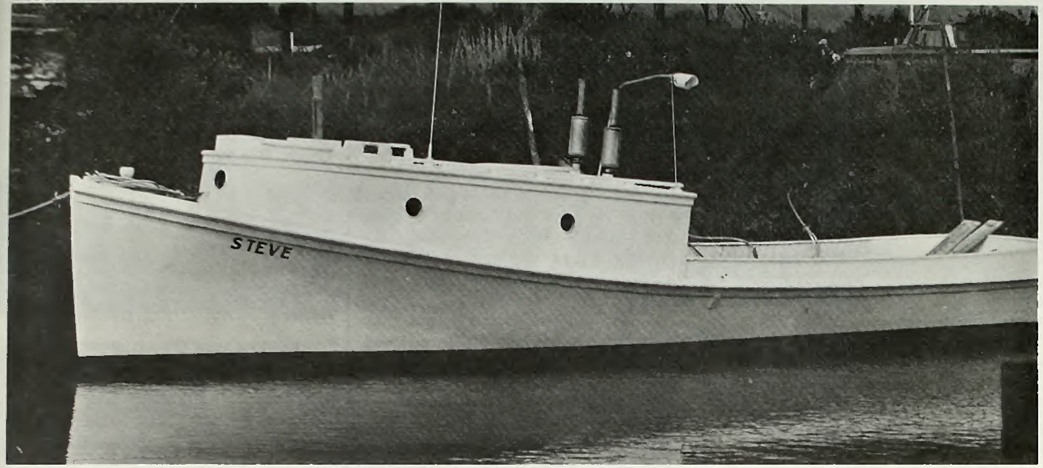
Some say it will take more than that to keep boatbuilding healthy on Harkers Island. One factor is lumber, which is getting scarce. Most of the island's boatbuilders say that if the lumber runs out they would quit building rather than

Photo by Neil Caudle

Photo by Cassie Griffin

Earl Rose and the old Rose Brothers boat shop on the island

Photo by Neil Caudle



The typical Harkers Island work boat, sporting its flared bow

switch to some other material.

But Rose is unimpressed by those who argue that wooden boats and craftsmanship are out of date.

"There will always be people who want wooden boats," he says. "There lays a boat right off yonder that is about forty-three years old, and it's still a good work boat. The man uses 'er in the roughest kind of weather, in the ocean."

Ask Rose about changes on the island, and he won't complain. He likes most of his new neighbors because, he says, they're mostly "retired," and willing to swap stories. He doesn't want to tear down the bridge.

"We haven't got any real mean people here," he says. "There's some nutheads, I call 'em, that like to run up and down the road and race their cars. But they don't interfere with me at all. I've got the house well insulated, so it ain't too much noise. There's just nothing here to change. If you want to go to church you can go, and if you don't want to go, that's your own desire, then. You do it like you want to do it."

Life among 'the loon eaters'

Back in the 1800s, on Shackleford Banks, families from Diamond City, the same families who would later help settle Harkers Island, ate loons.

The loons were more than a part of the islanders' diet. They were part of a community ritual. Each year, families would gather on the banks and drive flocks of startled loons into nets held high among the islanders' outstretched arms. Even after a rash of hurricanes in the early 1900s drove the population of Diamond City to the safer shores of Harkers Island and beyond, the loon hunts survived. The people of Harkers Island came to be known as The Loon Eaters.

Killing a loon is illegal now, but the name "Loon Eaters" still turns up occasionally in the conversations of older Down East families when they speak of the island. The term is a small part of the singular tradition of ritual and lore that help make life on Harkers Island what it is.

According to Jim Sabella, there are some almost failproof ways to pick out a native islander from the crowds of newcomers. You belong to Harkers Island if you or your family came there by way of the water—before the 1940s, when people still arrived by boat. You will also have, if you belong there, some strong connection with fishing and boatbuilding. And, you will speak with a generous measure of the Harkers Island brogue, so that "right" becomes "roight" and "scallops" becomes "sco'ps." (Harkers Islanders will tell you that they can tell from a man's speech whether he's from Atlantic or Salter Path or Harkers Island.) Your family would have shared, if not in the loon hunts, at least in the annual pony pennings on Shackleford, where the islanders gather to brand new foals born of the wild horses on the banks. And you would, if you belonged there, come and go among your neighbors' parlors and porches as comfortably as you do your own, since for generations your neighbors have shared with you not only their tools, their food and their labor, but also their island and their way of life.

From these traditions, the islanders have fashioned a culture as fertile as the estuaries they fish for a living.

Continued on next page

Families are close. Sons grow up working side-by-side with fathers, uncles and cousins. People are satisfied with their work. Young people grow up among strong people and strong traditions, with useful knowledge available at every hand. Even in their teens, young people grasp the quality of life on the island, and are reluctant to let it go.

Says 16-year-old Al Gillikin: "I'm going to be a commercial fisherman. That's what my father wanted to be, and that's all I've ever wanted to be. I love the water, just like he does."

"The thing that makes those people different from other communities where tourists have moved in is that they're not envious of those people that they see come down from the cities," says Bob Simpson, a writer and long-time student of the island. "In some ways, they're more sophisticated than the newcomers. But it's a quiet sophistication."

But however rich the traditions, there are signs that their grip on the island is weakening. The islanders have kept their independence and freedom largely because of their ability to remain almost self-sufficient in an age of specialization and dependence. Many of the islanders can recall living for months without any need for money. Supper was waiting out in the sound. There was no electric bills because there was no electricity. No paying job called them away from a boat that needed repair or a neighbor that needed help.

Most of that has changed. To meet the competition, fishermen are buying bigger boats and going deeper into debt. Fuel is suddenly a major expense. The cost of real estate on the island, thanks to the swelling population, is approaching big-city prices, so that young people who try to buy their own places face dizzying mortgages.

Debt and mortgages demand substantial, reliable incomes, and for fishermen and boatbuilders, those incomes are getting harder to come by. Sabella and Hepburn speak of fishing and boatbuilding as the two things most critical to the old way of life on Harkers Island. If those industries fail, the chain of "vocational succession," as Sabella terms it, will be broken and the islanders will find themselves working alongside their newest neighbors in factories, machine shops and offices, or in some "marine-related" job—perhaps even on a barge, a Coast Guard cutter, or a tug. New jobs, new lives.

Hepburn and Sabella won't try to predict the future of Harkens Island. The answers are not contained so much in the lives of the people there, they say, as in the forces bearing down on the island from all sides. But in an era when it's fashionable to speak of waters, earth and forests as "resources," Hepburn and Sabella point out that the way of life on Harkers Island is a resource as well—a cultural resource that has given the islanders satisfaction for generations. And, because North Carolina's fishing communities are similar, the things that haunt Harkers Island are likely to haunt other fishing villages, where the way of life, often equally as revered, is facing the abrupt intrusion of change.

Marcus Hepburn says that it's impossible to calculate what losing that way of life would cost the people of North Carolina.

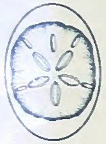
"We'd lose," he says, "the kind of things that you can't put a price tag on."

Photo by Ken Taylor

Islanders corral wild ponies and brand new foals during the annual pony-penning

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).



Since 1971, the N. C. Department of Agriculture has kept a close watch for the gypsy moth. In much of New England and the North, the moth's larvae have denuded and killed whole forests of valuable hardwood trees. One larva can eat a square foot of foliage each day. And, there have been signs that the moths are moving south.

The department's plant protection office has set out traps, baited with a synthetic sex pheromone, which attracts male moths to what they believe is the scent of a female. Each year, a few stray moths, probably "hitchhikers" that made their way south hidden in automobiles and campers, have shown up in the traps. But even on the Outer Banks, which get crowds of northern tourists, the moths were few.

Then suddenly, this summer, the traps were teeming. In just a few days, officials collected 4500 male moths from traps in Currituck, Camden, Dare, Perquimans and Pasquotank Counties. It looked as if the dreaded moth had chosen coastal North Carolina for its first big assault on the South.

But the department now believes that the invaders may have just blown in for a few days—literally. When they checked the weather records, officials found that strong winds from the north could have swept male moths into the Outer Banks, perhaps from the heavily infested Cape May, New Jersey, area. Female moths would have been too heavy with eggs to have come in the wind. No female, no larvae, and no destruction.

The department is still studying the Outer Banks for signs of the females—only males enter the traps—and won't really breathe easy until they're sure there aren't thousands of female moths laying eggs in North Carolina.

The UNC Sea Grant site visit will be held September 30 to October 2 in the Bogue Banks Marine Resources Center. A nine-member review team will assemble at the center for a presentation of Sea Grant's proposed coastal research for the next two years. If you're interested in finding out what the Sea Grant researchers will be up to, contact the Sea Grant office in Raleigh (919/737-2454) for information about attending a site visit session.

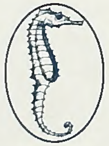
Members of the 1980 site visit team are: Thomas Murray and Kent Price, representatives from the National Sea Grant office; Ned Ostenso, director of the National Office of Sea Grant; Francis LaQue and Mike Pelczar, members of the National Sea Grant Advisory Panel; Dan Hunt, a representative of the Food and Drug Administration; Ford Cross, a representative of the National Marine Fisheries Service; Gene Woock, a specialist in the University of Wisconsin Sea Grant Marine Advisory Services; and Richard Pollnac, a faculty member at the University of Rhode Island.

How to Use Eels as Bait by Leon Abbas and Mary Day Mordecai, offers illustrated, step-by-step instructions for fishing with eels, a favored bait for many game fish, especially striped bass and cobia.

The booklet discusses tackle and hooking techniques, as well as how to select and prepare the eels. For a free copy of *How to Use Eels as Bait*, write UNC Sea Grant, P.O. Box 5001, Raleigh, N. C. 27650.

Someone travelling new ground needs a map, and so do fishermen casting into unfamiliar waters. If you're planning to launch your boat for a day of fishing in the Wilmington or Beaufort areas, you should take along one of Sea Grant's laminated, waterproof fishing maps. Measuring 19½ by 13 inches, the map pinpoints the most popular reefs, rock outcroppings, wrecks, and other fishing hot spots.

According to recreation specialist Leon Abbas, the map indicates by distance and magnetic headings the fishing locations in the Beaufort Inlet and Masonboro Inlet areas. Copies of the map can be obtained by sending $1.00 for each map to UNC Sea Grant.



With tarantulas, tree frogs and curly tailed lizards tucked safely away in baggage, 17 youngsters and their instructors flew home August 24 from Andros Island in the Bahamas. Their plane, a disheveled but sturdy DC3, had recently played a leading role in the new movie, "Dogs of War," for which it had been painted a sinister black.

But, as if reptiles and romantic aircraft weren't enough, the young people had something really special to tell the folks at home about: their first scientific expedition in the tropics.

The students, aged 12 to 17, are all "junior naturalists" or "junior curators" from the N. C. Museum of Natural History in Raleigh. The group was led by Ray Ashton, curator of education at the museum; Jesse Perry, the museum's extension educator; Patricia Ashton, a teacher at Ravenscroft School in Raleigh; and Lundie Mauldin, Sea Grant's marine education specialist.

The purpose of the week-long expedition was to show the budding naturalists how scientists work in the field. The Forfar Field Station on Andros Island is a center for research, and regularly accommodates school groups.

Continued on next page

Students gathered specimens for the museum's collection, mapped and described tropical ecosystems, identified plants and animals, and kept written logs. Mauldin and the instructors took the group onto a coral reef, where the students, equipped with snorkeling gear and "slates" for note-taking, studied territoriality among the fish there.

According to Mauldin: "We got to see one of the most diverse coral reef ecosystems, we got to see the culture of the Bahamian people, and, we got to see just how much a group of kids can learn in a short time."

When you cast your line into a run of spot this fall, you'll probably never think about how those fish got to be there. But Sea Grant researcher John Miller of North Carolina State University does. Miller and his graduate students, Mike Dunn, Larry Gerry, Jeff Woodward, and Woody Sutherland, have been studying spot, croaker and other juvenile sciaenids in Rose Bay, one of the state's estuarine nursery grounds.

The spot and croaker are spawned offshore, then migrate into the estuaries when they are about one-half inch long. The sciaenids live and feed in their nurseries for six months before returning to the ocean. Miller feels this six-month period in the estuaries plays a critical role in determining how many adult spot and croaker will survive. So he wants to know such things as what the spot and croaker feed on, what habitats they prefer, what temperature and salinity ranges they can withstand, and whether spot and croaker compete for food.

So far, Woodward has found that the sciaenids eat zoo-plankton until they reach a length of two inches. Then they turn to eating benthos, organisms that live along the estuary bottom. Miller was surprised to find that a part of the fish's benthic diet consisted of clam siphons, the tubular organs clams use to draw in water. This means spot and croaker may affect clam growth and populations and vice versa. Dunn and Gerry have found that temperature and salinity affect sciaenid survival rate. Sutherland has learned spot and croaker may be near the brink of exhausting the estuary's food supply.

What does all of this add up to? Spot and croaker are sensitive to change in their environment. And, if fishermen are to continue reeling these fishes out of the state's coastal waters, the sciaenids' nursery grounds—estuaries—will have to be preserved.

I want Coastwatch

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant. Box 5001, Raleigh, N.C. 27650.

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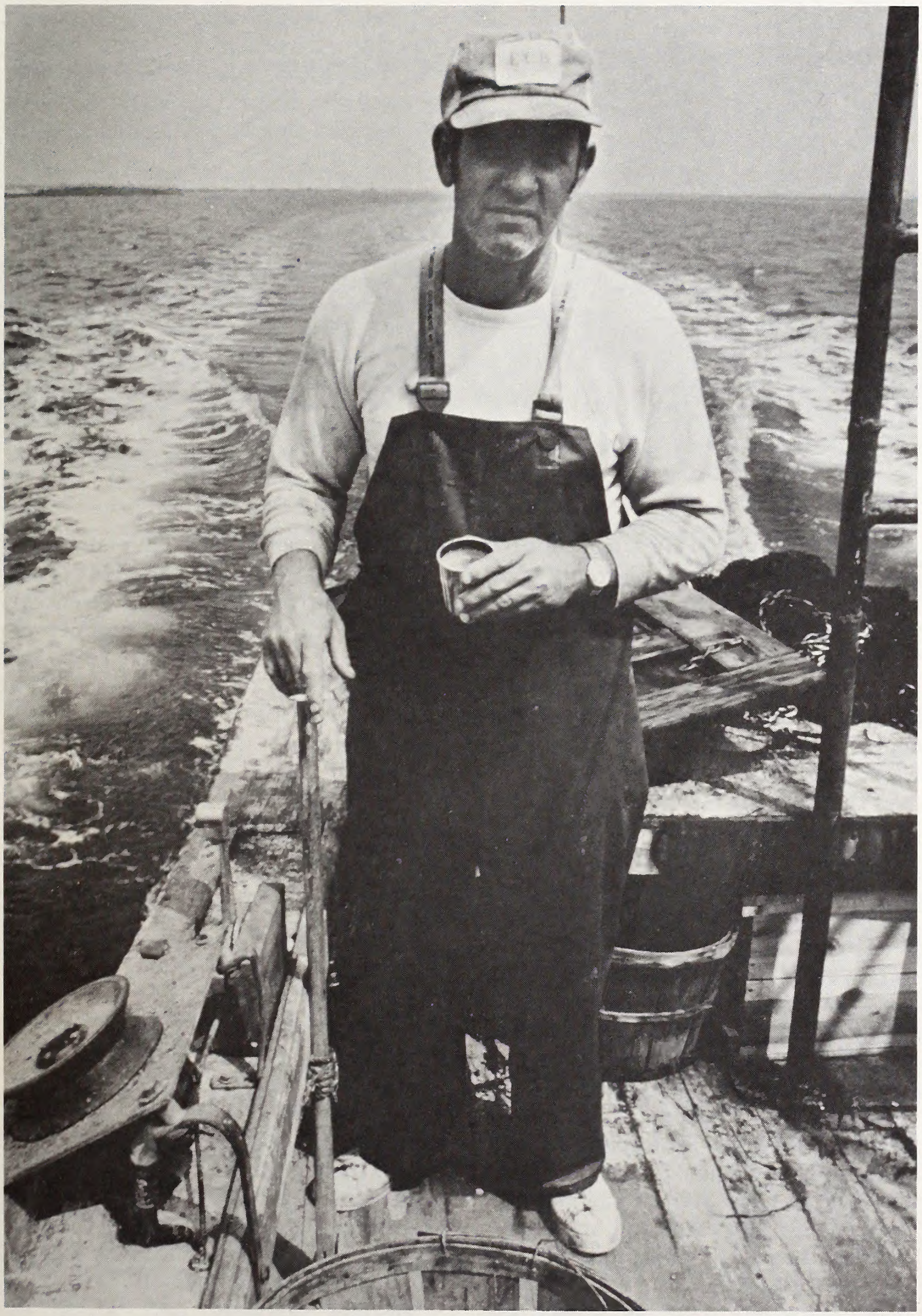

Bridges steers his boat toward a prime crabbing spot

Pots, peelers And blue crabs

The water still reflects the light from the nearly full moon as Murray Bridges, a crabber, starts the motor of his 25-foot boat about 4:30 a.m. The boat putters quietly out of its dock and down the creek by his Collington home, heading to the Roanoke Sound for the first haul of the day.

Bridges explains in his Outer Banks accent that the old adage of the early bird catching the worm is born out in fishing. "I don't know why, but early in the morning before dawn and at night about dusk are the best times of the day for fishing and crabbing," he says. "You can't lie in bed all day if you want to catch fish and make money. That's what I have to keep telling my boys."

Bridges has been crabbing the Roanoke Sound for the past eight years. He mixes his crabbing with a little shrimping in the summer and gill netting in the early winter. But mostly he crabs for hard crabs and "peelers" (crabs about to shed their shells). He crabs with wire-mesh pots or by dragging the sound bottom with a net, as he's doing this hot July morning.

Bridges lets the boat idle as he tosses the net and doors into the water. Next, he gears the boat into a slow, forward crawl, pulls out his thermos for a cup of coffee, and settles back for some talk about crabbing.

Bridges admits that he didn't know much about crabbing when he began. He had spent his earlier years in the Merchant Marines. But when he re-

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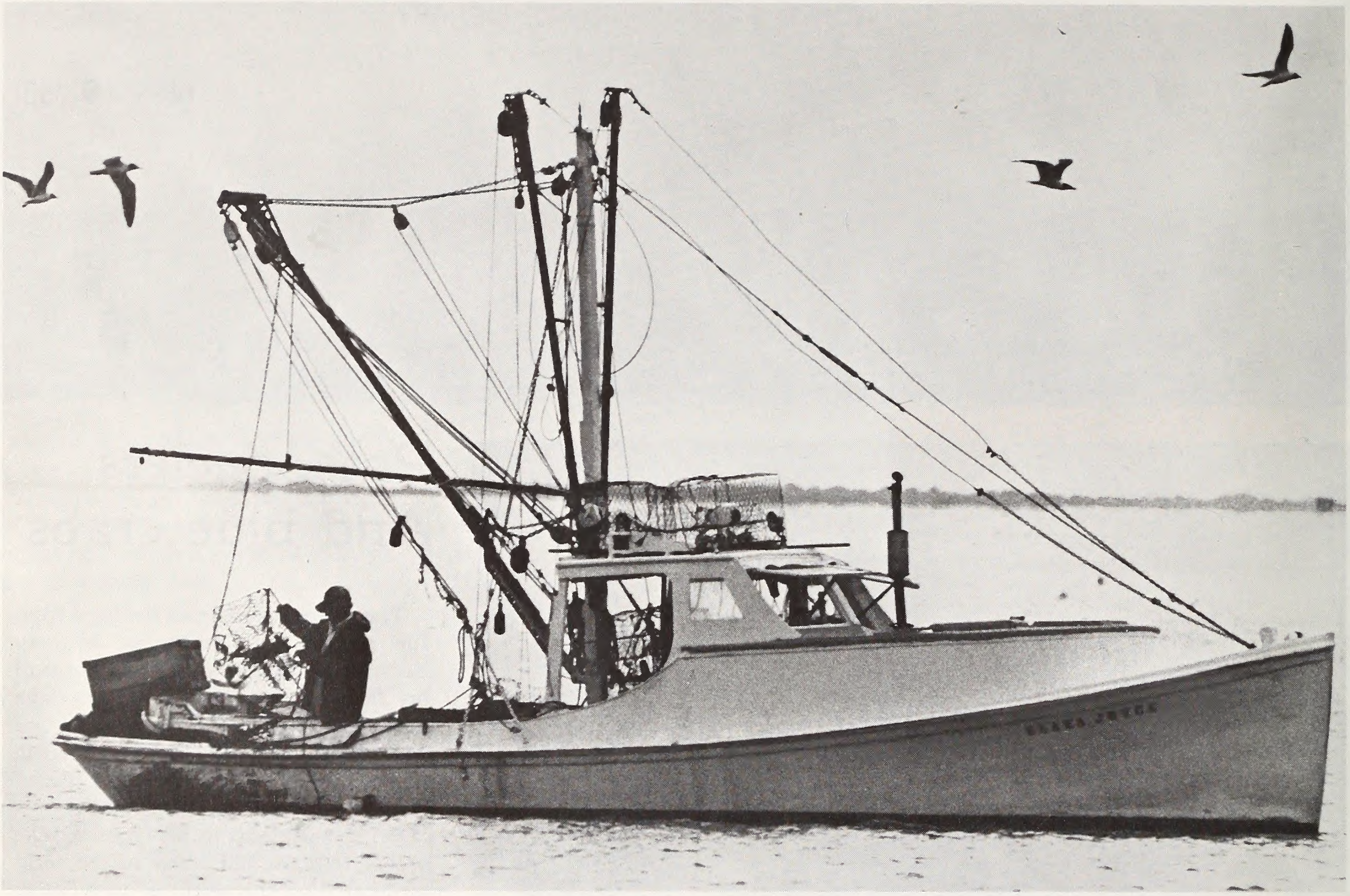
Photo by Steve Murray



A crabber checks his crab pots near Harkers Island

turned to his native Outer Banks he decided to take up crabbing. "If you like what you're doing, then you're going to want to learn more about it," Bridges says. "That's the way it was with me. I learned some by doing myself and the rest I've learned by talking with others."

For instance, Bridges knows that crabs are often concentrated along the sides of depressions or narrow craters in the sound bottom. "I figure the crabs like the sloughs 'cause the water is cooler there," he says. "And they settle along the sides 'cause the current runs too strong through the valley of the slough."

To make this "learned" knowledge pay off, Bridges has bought a depth recorder for his boat. With the recorder he can search out these depressions. "The depth recorder is an expensive piece of equipment that most crabbers don't have," Bridges says. "But for me it has paid off in better catches. I ain't like a lot of crabbers who think their way is the only way. I'm willing to try something new. I'm not set in my ways yet."

Bridges was one of the first crabbers in the area to try a hydraulic pot puller, which pulls the wire pots laden with crabs from the water. He rolls up his sleeve to show the veins that stand out along his lower arm. "See these?" he says. "They came from pulling up a couple hundred pots a day. My arms would just ache at night. Now I just feed the pot rope into the puller and it does the work for me."

Bridges says crabbing in the Roanoke is as good this year as ever. "It's not unusual to get 30 or 40 crabs in a single pot on a good day," he says. "The most I've ever caught in one pot was a hundred. But, there's a lot more people fishing crabs this year and that means more of us are dividing up the catch."

He boastfully claims that North Carolina blue crabs are as plentiful and large as Chesapeake Bay blue crabs, which often have been proclaimed the biggest and the best found anywhere. "Virginia hasn't got anything we don't have here in North Carolina," he says. "Our crabs are just as good, but Virginia does do a better job of looking after their crabs. They have all kinds of research going on at VIMS (the Virginia Institute of Marine Sciences) and the state limits the number of small crabs a fisherman can keep. By only allowing a very small percentage of a catch to be less than five inches wide, then naturally their crabs are going to look bigger and better to seafood dealers than ours." (North Carolina allows up to 10 percent of a crabber's catch to be less than five inches wide.)

"I think we need some tougher laws down here to make our crabs more competitive on northern markets," he says. "Now a lot of crabbers aren't going to agree with me about this 'cause they sell straight to picking houses and they get paid by the pound. So, all that matters to them is how much they catch, not what size they are. But crabbers in Virginia and Maryland grade their crabs out and sell the big number-one jimmies (male crabs about six inches wide) for more than the rest of the catch. They have to do a little more work, but it pays off."

Bridges certainly isn't afraid of work. He puts in 14 hours a day most days and often gets up during the night to check his peelers. "Crabbers certainly don't keep banker's hours," he says with a chuckle. Bridges usually makes three hauls with the net before noon. After lunch he must get his crabs to the dealer. He usually spends the rest of the day working with his peelers and making necessary repairs to his boats or nets.

About the end of November, Bridges stops crabbing and turns to gill netting until January when it becomes too cold for man or fish on the water. During the next two months, he makes major repairs to his boat and prepares for the coming spring by building around 700 new crab pots. Many crabbers don't build their own pots, but Bridges believes in doing almost anything he can himself.

The pots are two-foot cubes made from 1½-inch wire mesh. The inside of the pot is divided by an inverted-V partition. In the lower chamber of the pot, Bridges places four funnels by which the crabs gain entry. In the center of the lower compartment is the bait well that he baits with dead fish to attract the scavenging blue crab. The upper compartment of the trap is called the parlor. After swimming into the lower section of the pot to nibble on the bait, the crab, looking for a quick escape, rises upward through the holes in the parlor floor. Once inside the parlor, the crab is destined for the crab picking house.

As the conversation has progressed, so has the sun, and it's time to pull in the net to see what's been caught. After some heaving from Bridges and few squeaky turns of the wench, the first haul is dumped into a tray for sorting. There are crabs of all sizes, nine or ten handfuls of large brown shrimp and a few small fish.

Bridges pulls a thick rubber glove onto his right hand and begins picking out the crabs. The number-one jimmies are placed in one basket, while the smaller jimmies, she-crabs (immature female crabs) and sooks (mature female crabs) are placed in another basket. In a third pail go the peelers and in a fourth go the shrimp. The sorting takes about 15 minutes. When it's over, Bridges tosses overboard all the small crabs and fish. The laughing gulls, hovering close by, swallow this feast in seconds.

Other crabbers were plying the sound waters this morning. And, not long after we made our first haul, they began chattering back and forth about their catches. It seems no one was doing particularly well today. As the day got hotter and the catches smaller, Bridges was ready to call it quits. He had other work he could be doing if the sound wasn't going to relinquish anymore of its bounty today.

Blue crabs—beautiful swimmers and good eating

Stalked eyes, four pairs of segmented legs, one set of menacing, jagged claws and a hard, exterior frame that widens into lateral spikes combine to make one of the most succulent creatures on the East Coast—the Atlantic blue crab. Called *callinectes* (Greek, beautiful swimmer) *sapidus* (Latin, savory), the blue crab makes its home from Novia Scotia to Mexico.

Though some consider the crab an ugly creature, its meat ranks alongside shrimp and lobster as the best in seafood. But those who think the crab ugly have probably never seen a basket of crabs just taken from the water. Their white bellies sharply contrast their olive-green dorsal shells. Mature males wave arms of rich azure blue and females snap claws that are a bright red-orange. Hence, *callinectes* may not be as inappropriate a name as it might first seem.

Beside their uncanny beauty, crabs also display some interesting habits. One of those is shedding. In order to grow a crab must shed its hard shell, which does not expand. From the time it first hatches until it reaches full maturity, a crab may shed 25 to 27 times.

Crabs signal their impending change with a variety of signs that crabbers have described in colorful terms like "busters," "peelers," "red-sign" crabs and "white-rims." And, it takes a sharp eye and years of experience to detect the subtle signs of a crab's impending moult.

The first stage is the white-rim crab. If you look closely at the last leg or swimming fin of the crab, a thin white line can be seen along its inner border.

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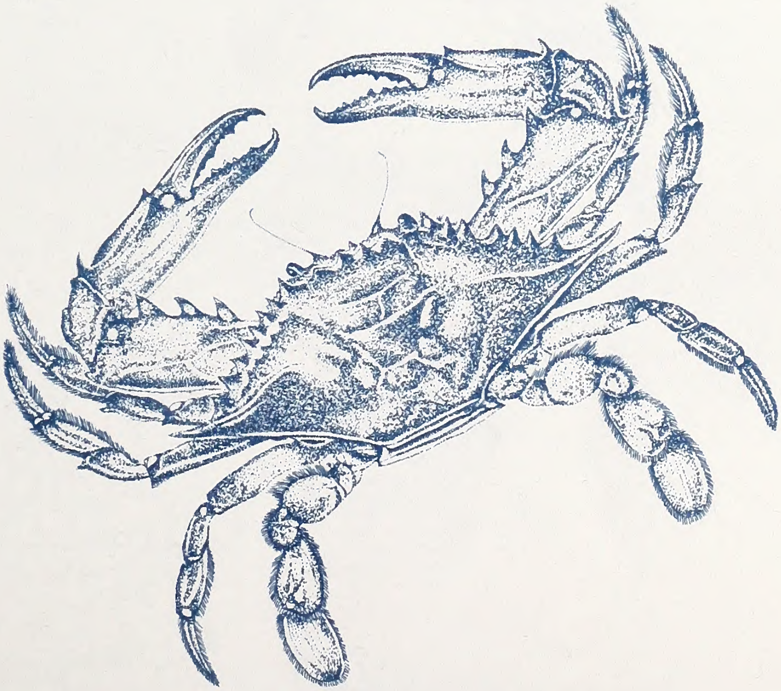
Illustration by John Kirtz



The blue crab

This means the crab will shed in about two weeks.

Gradually this white line will turn pink and then red. A red-sign peeler is only two days from shedding.

A crab is "rank" just before its shell cracks and it's a "buster" once the soft crab begins backing out of its old shell. A crab may grow as much as two inches after it sheds. The crab appears almost lifeless after it moults because of the tremendous energy it takes for the crab to withdraw from the old shell. When in its soft shell stage, the crab is most vulnerable to predators. After six or seven hours, the shell begins to harden to the consistency of paper. Hence, the name papershell crab. After two days, a crab again has a hard shell.

Another interesting aspect of shedding is mating. A female crab can only mate during her last moult, when she reaches maturity. An immature female crab or she-crab has a V-shaped apron, while a sexually mature female crab or "sook" has a semi-circular apron. But it is only during the change from the V-shaped apron to the semi-circle apron that the female can mate.

During an elaborate courtship, the male and female wave their arms and legs to catch each other's attention. Finally, the female backs herself beneath the male. He grabs her with his walking legs and cradles her beneath him until she is ready to moult. Crabbers call these mating crabs "doublers" or "buck and rider." The male may carry the female for two to three days and travel long distances before the moulting occurs. When the female is ready to shed, the male makes a protective cage around her with his body. Once the female has shed and the mating has occurred, the male again will cradle the female until her shell is hard.

Photo by Neil Caudle

Bridges holds up a "rank" peeler from his shedding tray

Shedding crabs-A 24-hour job

Murray Bridges may enjoy crabbing, but his real love when it comes to crabs are his peelers. Row after row of concrete trays stand outside his Collington home for shedding out peeler crabs.

Bridges began a small peeler operation several years ago when crabbers were just beginning to shed crabs in trays over land. Chesapeake Bay crabbers have been shedding crabs for years in wooden trays, called "floats," which they staked in the water. The crabbers would have to paddle their skiffs alongside the trays to remove the soft crabs. But scientists learned that crabs would shed just as well in trays or tanks on land if they had a constant supply of water from a nearby creek or estuary. And that's just the kind of operation Bridges has set up.

The prime peeler month is May. About the first of the month, Bridges begins jimmy potting. He baits his traps with several large jimmy crabs in the parlor section of pots. The jimmies attract the she-crabs that did not make their final mating moult the previous year.

"The jimmies can attract 20 to 30 rank female peelers in a single pot," Bridges says. "You know how they say women always chase men during leap year. Well, every spring we have a leap year with crabs. Those females go right to the males," he says with a chuckle.

But jimmy potting only lasts until about mid-June. After that, for a reason unknown, jimmy potting no longer attracts female peelers.

Not only is May a good month for female peelers, it is an excellent month for peelers in general. Like almost every other creature of nature in the spring, the crab casts off the old of winter and takes on the new of spring. And all of this shedding makes a jackpot for peeler crabbers who get prices like $8 to $10 a dozen.

But, Bridges is not getting rich. A peeler operation requires a major investment in money and time if it is going to pay off for the crabber.

For instance, this year Bridges added 30 or so new concrete trays to expand his peeler operation. He built about 700 pots, which cost $6 to $8 each. He must consider rising prices for operating his boats. And there are countless other costs for everything from the wenches on his boat to the huge freezer he uses to store his crabs before shipping.

"So far this year I haven't come even on my investment," Bridges says with a sigh. "People think you're making a lot of money when you tell them how many you shipped and the price you're getting for soft crabs. But what they forget is the money it takes to make that shipping possible."

But money isn't the only expenditure it takes to make a peeler operation successful. It takes time—24 hours of it. The trays must be checked every four or five hours religiously for newly shed crabs and dead crabs.

Bridges says he lets a crab "firm up" for about an hour after it has shed before he removes it from the water for packing. But he can't let the crab firm to the papershell stage, which can begin as early as six or seven hours after shedding.

If a crab reaches the papershell stage then it is worthless to the crabber and is usually discarded. But Bridges is trying to work up a market for the papershell. Stripped of its thin shell and legs, the papershell can be fryed in a light batter and eaten just like the soft shell crab.

Sea Grant advisory agent Hughes Tillett of Manteo and seafood specialist Sam Thomas of the NCSU Seafood Laboratory in Morehead City have been helping Bridges develop a market for the papershell by asking restaurant owners and seafood dealers to give the papershell a try.

Bridges thinks it is the papershell's name that turns people away from trying the crab. "I think if you could get 'em on the market under a different name, then you could sell 'em like hotcakes," he says.

Bridges sells his soft shell crabs to seafood dealers in the north where he can get top-of-the-line prices. "Last year I was asking 25 cents more than most Chesapeake Bay crabbers and they were still meeting my price because they told me mine were the best-looking soft shells on the market," he boasts.

Bridges says he would eventually like to do nothing but shed crabs. "I would like to buy the peelers off the crabbers in the area, shed 'em out, then sell 'em up north," he says. "I figured it out and we'd both be better off that way. A lot of crabbers wouldn't waste their time and money trying to shed their crabs if they had a shedding house to take their peelers to. That's the way they do it in Maryland and Virginia."

Processing a valuable product

With freshly steamed crabs piled high before her and a dozen plastic containers to the side, Lue Lewis is all business as she rhythmically cracks and extracts the sweet meat found in blue crab claws. A veteran crab picker of 18 years, Lewis works for the Luther Lewis and Son Seafood in Davis, one of the 30 commercial crab processing plants in North Carolina.

The crab meat industry is big business in this state. According to Sam D. Thomas of the North Carolina State University Seafood Laboratory in Morehead City, a record 26 million pounds of live blue crabs were landed in North Carolina last year. A $16 million industry, commercial crabbing owes most of its wide distribution and increasing demand to the 30 processors and picking plants. Here, local and plant crabbers sell their catch, grading out the number ones (big jimmies or male crabs) for the basket market and the number twos (generally male crabs under six inches) and number threes (sooks or female crabs) for picking. The spring basket market in North Carolina begins around mid-June when the Chesapeake crab supply is low and the Baltimore steamed-crab restaurant demand is high.

To prepare the other blue crabs for picking, baskets holding several hundred pounds of the crustaceans are steam-cooked in large retorts. Thomas says that a small operation, employing about 10 pickers, can pick approximately 4,000 to 5,000 pounds of crabs a day. An average 10 to 15 percent return will yield 400 to 500 pounds of the delicious meat.

Demonstrating a high degree of manual dexterity at full production, pickers' flying hands and nimble fingers blur as they extract meat for which they get about 80 cents per pound. The crab meat is divided into three basic categories: prime lump or backfin, which is only about two percent of the live weight; special or flaked meat; and the claw which yields cocktail claws and claw meat. When picked and packed by weight, crab meat is marketed as fresh-cooked meat, pasteurized meat, fresh or frozen patties and canned cooked meat or soups.

The majority of the pickers in North Carolina's processing plants are women, older women. Lue Lewis and Mary Willis, another 18-year veteran picker, enjoy the routine work, additional income and family-type atmosphere, but admit there's little future in it for young people. The often long days, which can be dull and frustrating, make this type of work unappealing to many except as a temporary job. Sam Thomas predicts labor will continue to become more undependable as the older women retire, leaving vacant chairs at the picking table.

Mechanization is being tested in North Carolina with more than one processor expressing an interest beyond mere curiosity. This past April, the Seafood Lab gave a demonstration on mechanical crab picking equipment, inviting all state processors. Over 75 percent, the best response ever, attended and asked questions. One processor in the state is using mechanical equipment this year, yet he still retains a regular picking crew to get the claw and lump meat his machine is incapable of extracting.

Continued on next page

Machines, many processors and pickers alike argue, don't yield the better "bone-free" meat demanded by restaurants and consumers, and picked by experienced hands. Many claim that the machines have a long way to go, producing meat now that "looks like it chewed it all up and spit it out for bad." However, most processors are aware their businesses' futures will soon rely upon the dependable and time-efficient labor source found in the new machines being perfected through modern technology.

Sanitation, another problem in the business, can also be checked better through some mechanization. Unsanitary pickers, flys in the picking room and improperly cleaned tables are the prime sources for a high bacterial count in crab meat. Spoilage, poor handling and equipment breakdown can contaminate this very valuable and expensive product and cause a plant to be shut down.

When a person's health is at stake, federal and state regulations come in to ensure good sanitation and a good product. Shellfish Sanitation, under the State Department of Human Resources, is the controlling agency responsible for issuing plant permits. The United States Food and Drug Administration also makes periodic inspections of each processing plant, from the loading docks where the crabs are landed to the final packaged product under refrigeration. Samples are taken and sent back to labs for bacterial count checks. And it takes an efficient and spotless business to pass the strict regulations enforced by the state and federal government.

Waste disposal is the biggest problem the processor faces daily. The majority of the processors in North Carolina haul their waste to landfills or farmlands where it can be tilled under daily. James Paul Lewis, owner of the Lewis plant in Davis, uses his waste as prime fertilizer on his farm. A few local hog farmers take the nutritional solid crab waste to supplement their feed. But these methods aren't solutions for all processors nor for all of the waste that can be generated on a good day. Some waste does end up being dumped in creeks, left uncovered at landfills, or deposited by the picking plant.

Crab reduction equipment is the best means of waste disposal, according to Thomas, but not economically feasible for the small plant operator. Crab reduction involves dehydrating the crab meat waste and grinding it to make such products as chicken feed. There are several commercial reduction plants and a common dryer in Pamlico County available for a fee, but most processors either don't want to haul large amounts of waste or aren't even near the dryers. Thomas warns that as demand for crabs increase, so will the waste, becoming more of a problem in the next couple of years.

However, despite some irregular moments with crabbers, owners and pickers to meet seasonal and inconsistent demands from consumers, the crab business is a very healthy, growing business. Frozen-food concerns now use over 45 percent of all of the blue crabs landed in the United States, making this delicious product even more available and widely distributed. With an increased emphasis placed on healthy foods and gourmet cooking, crabs and all other forms of seafood have been in great demand. And, when the chance to get the fresh, sweet meat of North Carolina's blue crabs comes to most people, very few turn it down.

Photo by Cassie Griffin

Veteran Mary Willis extracts the backfin meat of a blue crab

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

Rip currents along the Outer Banks killed five people in August. Rescuers battled the heavy surf to save many others. The deadly currents were blamed on a combination of things: several days of northeast winds, which mounded nearshore waters especially high; a full moon, which further raised the tide, and Hurricane Charlie, making waves from off the coast of Virginia.

The pull was intense, but not unusual. Rip currents are common in North Carolina. They can form when water, shoved against the shoreline under pressure, breaks through a sand bar and rushes to sea at a rate of several feet per second. Rip currents can also form when longshore currents moving in opposite directions meet, often in a bay, or when a longshore current is diverted by a jetty or some other structure.

How can you avoid them? Watch the signs: especially green or murky water, a gap in advancing breakers where the current pushes seaward, or a floating object that moves steadily seaward.

If you're caught in a current, don't panic. Don't try to swim against the flow. Instead, swim diagonally toward shore until you break the current. If you can't break it, float calmly out with the current until it dissipates, usually just beyond the breaker zone.

For more about rip currents, write for Sea Grant's free poster, "Rip Currents." The address is UNC Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650.

When it comes to seafood, North Carolina and Japan have a lot to talk about. That's why Frank Thomas, project director of seafood science and technology for UNC Sea Grant's marine advisory services, is studying Japanese.

Thomas, along with 18 other North Carolina State University faculty members, have been invited to spend the fall semester of 1981 in Japan. The trip is part of a university program established to link North Carolina and Japan more closely in a range of fields, from food science to textiles management.

Thomas will share with the Japanese the latest in American seafood technology, and will in exchange, bring home Japanese innovations. He will visit fishing vessels, processing plants and laboratories. He will also bring home a deeper understanding of Japanese culture—an understanding that he believes will help professionals develop new markets for North Carolina seafood and keep information flowing between the two peoples.

For Thomas, the trip will tie in nicely with a liaison he established with Japan in 1968. Through that effort, North Carolina and Japan have already traded ideas and technology related to minced fish, seafood processing techniques and market development for underused species of fish.

It read like a movie script. Loudspeakers blasted warnings to swimmers to stay out of the surf as schools of sharks roamed the waters close to the North Carolina shoreline. But the situation was real and danger was present.

The North Carolina Division of Marine Fisheries called the shark alert, the first one ever, August 9, after Dr. Frank Schwartz of the University of North Carolina Institute of Marine Sciences reported finding an unusual number of sharks near the shore. Schwartz said the high temperatures in July and August had driven up water temperatures and driven away the shark's normal food supply. The search for food coupled with an onshore current brought the sharks toward shore.

Carteret County officials banned swimmers from the water August 9 and 10 along 26 miles of coastline from Atlantic Beach to Emerald Isle. The county became the center of state and national attention as reporters called county officials and fisheries experts to get the scoop on the patrolling sharks.

No one was attacked along Carteret beaches, but a 10-year-old Greensboro girl was bitten in the leg while wading in the surf at Ocean Isle Beach in Brunswick County. There have been only two other victims of confirmed shark attacks in North Carolina. Connell Purvis, director of the Division of Marine Fisheries, told reporters that the attack was an isolated incident and unrelated to the sharks sighted near Carteret County.

The alert was lifted August 10 as the sharks moved back out to sea.

No longer will it be just fishes, sea mammals and trawlers plying the watery depths of the mid-Atlantic continental shelf. Scientists will be too. The National Oceanic and Atmospheric Administration (NOAA) has awarded funds for an underwater research, training and education program, the Southeastern Consortium for Undersea Research Efforts (SECURE). It will serve Virginia, North Carolina, South Carolina, Georgia and Florida. The Southeastern Undersea Research Facility (SURF) will be on the campus of UNC-Wilmington.

According to Harold Dubach, SURF's administrative officer, SURF is gearing up for operations by out-

Continued on next page

fitting an 80-foot converted trawler, the *Seahawk*, with a decompression chamber and other diving equipment. "We're putting together an experienced diving crew and we've already received about 30 proposals for research," Dubach said. Proposals for underwater research are unlimited, he said, and include questions about marine medicine, underwater archaeology, fish populations, ocean pollution and underwater geology.

During Phase I of the SURF program, plans are for divers to study and conduct experiments at depths of 90 feet in a wet diving bell. Later in Phase II, researchers will be able to descend to depths of 200 feet in a dry or closed diving bell. Eventually, plans are to develop a mobile underwater habitat.

SECURE is the fourth undersea project to be funded by NOAA. Others are located in Hawaii, California and the Virgin Islands.

Homegrown tomatoes and cucumbers certainly are a delicious reward from your backyard garden, but what about largemouth bass? That's right, largemouth bass, and it's just one of the species suitable for water gardening, says John Foster.

Foster works with water gardening, or aquaculture, at the North Carolina State University (NCSU) Eel Culture Project in Aurora. Home aquaculture as a hobby, he says, is one of the cheapest and most efficient methods of producing meat. And, North Carolina has an abundant groundwater supply and excellent climate.

For the interested gardener, there are several methods of cultivation: in ponds, creeks or rivers; in an indoor greenhouse, or in a basement tank. Pond aquaculture generally requires an area drainable by gravity (no pumps), three to five feet deep. It should not flood, and it should have an efficient soil lining to hold water. A small garden pool or cages set in flowing water are other alternatives for outdoor aquaculture.

Indoor aquaculture involves more control over the environment, Foster says, and "absolutely requires recirculation or filtering of the water." Tanks can be constructed of concrete blocks, waterproofed and sealed, or swimming pools with plastic linings are acceptable. A combination greenhouse-aquaculture system provides benefits to both plant and fish cultivation, often stabilizing the environment's temperature and eliminating the need for a heater. Even edible plants, such as watercress, can be grown in the tank's ecosystem.

For warm water systems, the following species are recommended: catfish, bullheads, crayfish, prawns, largemouth bass, eels, tilapia, bluegills and Chinese carp. Cold water species require more oxygen in the water and a much greater flow, but rainbow trout, yellow perch and coho salmon are suitable for this type of cultivation.

For the beginning aquaculturist, it is important, Foster says, to be familiar with the lifestyle and needs of the species stocked, in addition to the maintenance and most efficient use of the aquaculture system. For more information, contact John Foster at the NCSU Eel Culture Project, Route 2, Box 305, Aurora, N.C., 27806, or telephone 919/322-4054.

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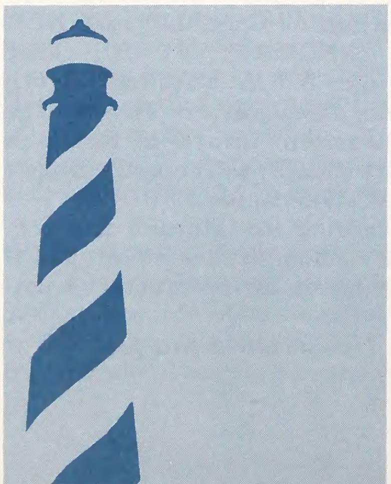

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COAST WATCH

Photo courtesy of The Carteret County News-Times

Crowds gather at the marina as this blue marlin is weighed in

A winning sport And season

The last wet towel and sandy kid have been retrieved, the car is packed, and the beach house is locked up until next summer. While Memorial Day signals the beginning of the tourist season on North Carolina's coast, Labor Day weekend marks the end.

But fish and fishermen have never been known to restrict

Continued on next page

their activity to the tourist season. So before the crowded beaches can fade into a postcard memory, the second season begins when the saltwater sportfishing tournaments fill the coastal communities again.

And, it's a profitable season for North Carolina. In a 1978 survey, North Carolina ranked fourth in the value of its saltwater sportfishing (behind Florida, California and Texas). Leon Abbas, Sea Grant's recreation specialist, says: "Not only do the coastal communities do a fine job of handling the tournaments, but North Carolina also has the availability of many types of fish and fishing."

Three kinds of saltwater tournaments are very popular in this state—billfish, mackerel and surf fishing. Although tournaments unite fishermen in competition, each type has its own distinct organization and methods of fishing. Jim Bahen, a Sea Grant marine advisory agent, and tournament fisherman, provided some of the following information on equipment costs and baits.

Surf fishing tournaments in North Carolina are generally held in the spring and fall when the bluefish, channel bass, drum, croaker, flounder and trout are biting. Two of the oldest events are the Nags Head Surf Fishing Tournament and the Cape Hatteras Anglers Club Surf Fishing Tournament, both held in the fall.

In a typical surf fishing tournament, 70 to 85 six-member teams register. A drawing held on Wednesday evening assigns each team the four positions they will fish Thursday and Friday. With a different position for each morning and afternoon session, every team has an equal chance to win. Each position, called a station, is approximately one-fifth mile in length and marked by the club. Once fishing begins, judges patrol the beach in four-wheel-drive vehicles, measuring and recording each catch by length.

The basic equipment for surf fishing is a surf rod and reel, which cost about $125 for top-of-the-line brands. Surf rods are longer than traditional rods, usually 10 feet, and feature either spinning or conventional reels. Artificial or natural bait can be used in competition. The Hopkins is the favorite artificial lure and cut-up mullet the choice in natural bait. Most surf fishermen also own four-wheel-drive vehicles for beach access and transportation to stations.

Because the longest fish earn the most points in surf fishing competition, each team strives to catch a great number of fish, hoping for a least a few large ones. According to Fritz Boyden of the Nags Head Surf Fishing Club, "Bluefish and gray trout are the predominant catch of the day, averaging 15 to 18 pounds each. I remember one tournament," he recounts, "where we scored 17,000 points in the two-day competition. When we figured the points, it was somewhere in the neighborhood of 11,000 fish with the average fish weighing about a pound and a half. Now that's a lot of fish."

No cash awards are given in these tournaments, but trophies and other prizes abound for the team scoring most points overall, for the most points in each session, for the largest fish, and for the angler scoring the most points, just to name a few of the categories. Anglers take home trophies, plaques, trays, rods, reels, tackle and other equipment. The Cape Hatteras Anglers Club awards its first place team a replica of the Cape Hatteras lighthouse, complete with an electric beacon.

Surf fishing is not just for men, as Cape Hatteras Anglers Club President Toni Zindel will attest. "We have both men and women on teams, several all-women teams and couples registering as teams," she says. "They are all ages, and they come from all walks of life with at least one thing in common—they just plain enjoy fishing."

For many years, offshore fishing was limited to wealthy anglers who could purchase and maintain the large seaworthy vessels necessary for this type of fishing. But, in recent years, smaller, more economical boats have been introduced, enabling the middle-class fisherman to compete offshore.

Mackerel fishing, the newcomer to North Carolina tournaments, is excellent for the smaller boats. Not only are mackerel smaller than billfish, but they can be caught within 10 miles of shore. The number of local anglers competing has increased as excellent prizes are available with a much more modest investment.

Mackerel tournaments generally begin with a pre-tournament meeting on Friday evening and fishing from early Saturday morning until Sunday afternoon. Usually, three people fish in a small boat and three to five in a large boat, manned by a captain and mate. Boundaries are set by the sponsors, and boats may weigh-in three fish per day.

Equipment for mackerel fishing can easily run from the basics to the best. A good rod and reel capable of landing a 40-pound fish can be had for $50, though some anglers will be reeling in fish on a $225 outfit. And, sharing the waters with custom-built vessels will be the most common boats for this

Landing a marlin requires the strength of several crew members tournament—small inboard-outboards ranging in length from 16 to 30 feet and in cost from $4,000 to $60,000.

Mackerel will strike either artificial lures, including the Sea Witch or Drone Spoon, or live baits such as menhaden and pinfish. Mackerel fishermen tend to save money on bait by catching their own.

Scoring for prizes varies in mackerel tournaments. First prize in the Wrightsville Beach King Mackerel Tournament, a $2,500 cash award, is determined by the combined weights of a boat's three largest fish. But the largest fish landed wins the U.S. Open King Mackerel Tournament in Southport, and the sponsors think this arrangement is fairer to the small-boat owner.

According to John Barbee, chairman of the second annual U.S. Open, 374 boats competed this year in the event, which was held October 2 through October 4. Barbee says such a high attendance can be attributed to the rewards, as first through third prizes were $10,000 in cash, a Jeep CJ5 Renegade and a McKee Craft boat, motor and trailer. The winning fish weighed 43 pounds, 4 ounces.

The marlin season in North Carolina runs from mid-May through September and provides plenty of excitement for five tournaments: Pleasure Island Tournament at Carolina Beach, Cape Fear Marlin Tournament at Wrightsville Beach, Big Rock Marlin Tournament at Morehead City, Hatteras Marlin Tournament at Hatteras and the Oregon Inlet Billfish Tournament at Oregon Inlet.

A pre-tournament meeting and registration also begin billfish or marlin tournaments, which generally schedule three or four days of fishing. Competition times are set by the sponsors with most boats leaving before sunrise to reach the fishing grounds (50 to 60 miles offshore) by starting time. And, after a full day of fishing, there is still the long haul back to the marina to weigh the catch.

Some tournaments are designed to run a whole week, from the meeting on Sunday evening, fishing on Monday and Tuesday, a "lay day" on Wednesday, more fishing on Thursday and Friday, and the awards banquet Saturday evening. At these extended competitions, many of the boats registering will be from out of state and part of the "circuit" of tournaments up and down the East Coast. Characterized as members of the leisure set, or the elite, marlin tournament fisherman can afford to pursue this expensive hobby.

Just as surf fishing and mackerel tournament fishermen gear their equipment to the particular species, so is marlin tournament equipment geared to catching and bringing in large offshore fish. An average blue marlin may weigh 250 pounds and measure 8 to 10 feet from tip of the bill to tail. Equipment ranges from the best to even better. A custom-built rod and reel capable of holding one of these monsters can cost $500, with factory-built outfits running about $300. Although some small outboards may compete, billfishing boats are 30 to 60 feet long and starting at $30,000. The majority of the boats in this field of competition are custom-designed and worth at least a quarter of a million dollars. Even to the innocent bystander, these boats are a thing of beauty, from the plush interiors to the highly polished brass fixtures and teak decks.

The good book says
every day you fish
the good Lord gives you
another day.

—Fritz Boyden
Nags Head
Surf Fishing Club

In a marlin tournament, boats cover a tremendous amount of water offshore and fish for not only blue and white marlin, but sailfish, dolphin, wahoo and king mackerel as well. Artificial and natural baits are trolled, with natural bait choices including Spanish mackerel, squid, ballyhoo and mullet. More bait is also used in this type of tournament, with an average daily expense of $50 for natural baits.

One of the most exciting aspects of marlin tournaments is the weigh-in at the marina the end of each fishing day. Spectators arrive early to watch the sleek boats come in and check for the white and blue flags flying (designating white and blue marlin caught). Once a fish is weighed and recorded, the amount and boat's name are marked in chalk on it. Every angler and spectator hopes for a good day like the one Jack Herrington had in 1974 when he brought in a blue marlin caught off Oregon Inlet. It weighed in at 1,142 pounds, setting a new state record that remains unbroken.

Although there are more of the monster fighting marlins like Herrington's in North Carolina waters, the winning fish in a tournament generally weighs about 500 pounds. Often, a cash prize of $1,500 is awarded for the biggest blue marlin with smaller cash awards for other species and special honors, such as the first blue marlin over 400 pounds or last blue marlin caught.

If the prizes awarded in all three tournaments seem small in comparison to the investment anglers may have, remember they are really only the tip of the iceberg. There is an age-old tradition in tournaments that often outclasses the actual event in terms of excitement and competition—the Calcutta. Basically a jackpot, the Calcutta is established during the pre-tournament meetings when registered boats or teams are auctioned off to the highest bidder. It is not unusual in some tournaments for the Calcutta to be 10 times greater than first prize, or even higher.

Another common thread in all three types of tournaments is the hard work involved. Several tournament leaders said planning for the next tournament begins the day after one is over. Arrangements have to be made for entertainment (meetings, social hours, banquets), judges and scoring, trophies and awards, program books, invitations, registration, publicity, cooperation from marinas and communities, and many other details. Almost all of this work, plus the full-time staff working during a tournament, comes from volunteers from either the organization or the community.

Even with volunteer help, expenses can be several thousand dollars. Entry fees, which range from $50 to $175, pay most of the expenses. Tournament sponsors also defray some of the costs by selling the fish. But tournaments are primarily not profit-making functions. Any funds leftover go back to the club or sponsor or into the community. And, the sponsors and organizers all admit that a tournament is just as much fun for them as for the winning team or boat.

Profile of a tournament fisherman

Until recently, there were very few tournaments in North Carolina, and these were generally held for billfish with competition dominated by the wealthy fishermen, many from out of state. But with rising incomes, more economical equipment and a resurgence in the coast as a recreational site, more tournaments have been organized. The tournament scenario has also changed to include the middle class and local fisherman.

Marlin, mackerel and surf fishing—the fishermen are as diverse as the tournaments. What is the difference between a surf fisherman and a mackerel fisherman? How do the tournaments differ? What impact will this have on us? These and many more questions have been asked by local communities who see their beaches and waters becoming populated with fishermen in the off season.

To answer these questions, a Sea Grant project studied tournament and recreational fishing. Sea Grant researchers Leon Abbas and Peter Fricke mailed surveys to participants in 13 saltwater tournaments held on the North Carolina coast in 1979. From a field of 1,060 participants, 53 percent of the surveys were returned, and the data were compiled and analyzed.

"With this information," Fricke says, "we can determine the socioeconomic impacts tournaments have upon local communities and the North Carolina coast, and the social organization of a particular recreational activity."

Here's what they found. The average tournament fisherman—we'll call him Joe—fishes eight to 10 years before he enters his first tournament. Joe is almost 42 years old and has a college education. With almost six years of experience in tournament fishing and over 17 years in sport fishing. Joe enters at least four tournaments a year, traveling an average of 164 miles to each tournament.

Earning a median income of $70,000. Joe's expenditures for tournaments in 1979 were distributed this way: fuel and oil, 32 percent; lodging, five percent; bait, tackle and ice, 12 percent; food and beverage, 14 percent; boat services, seven percent; travel (public), 15 percent; crew costs, 14 percent; and miscellaneous, one percent.

Abbas figures that Joe and his tournament party spend approximately $978 to participate in each tournament, and this didn't include the entry fee. In addition to the expenditures in the tournament community (breakdown above), Joe and his friends also purchase en route gasoline, fishing gear and food.

Photo by Cassie Griffin

Toni Zindel, president of the Cape Hatteras Anglers Club

As Joe begins to specialize in a particular type of tournament, several new factors become important. Jim Surf Fisherman is primarily middle class (he has a mean income of less than $30,000), fishing in a team with five other people. He really can't afford to take much time off from work, so the tournament's weekend scheduling is just right for him and his family. Often, he will schedule a week's vacation if two consecutive weekends promise tournaments within a reasonable distance of each other. Jim may even have his wife and two other couples comprising the team, which will definitely see both men and women in competition.

A new breed in tournaments, Tom Mackerel Fisherman is also middle income (mean income is less than $30,000) and either self-employed or a professional in a technical industry. This job status allows him to take off periods of time to travel to and enter more tournaments. About 20 percent of the competitors Tom will encounter are business partners and acquaintances like the two or three friends who fish with him. To accommodate these friends on the water, he owns a small boat, approximately 18 to 26 feet long, which can be trailered. Almost no women compete in these tournaments.

The wealthiest of the three, Bill Marlin Fisherman, has a mean income of almost $80,000 with a great number of his friends earning over $100,000. He often travels an East Coast circuit of tournaments in his company-owned boat which is definitely too large to trailer and is expensive to maintain. Bill hires a professional crew to man his boat and attend to the needs of his business associates on board. Again, almost no women compete.

With this information and more specific data from the survey, both sponsors and communities could see the tourism benefits reaped during the tournament season. Toni Zindel, president of the Cape Hatteras Anglers Club, says their surf fishing tournament was started over 23 years ago to encourage people to come down to the coast for the excellent fall fishing.

Melanie Ply, executive vice-president of the Outer Banks Chamber of Commerce, is a believer in the tournaments. "Not only does it lengthen the tourism season on the Outer

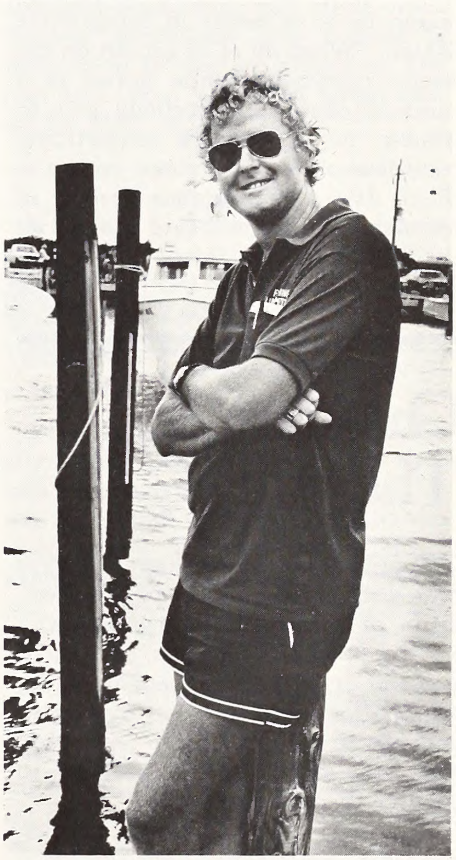
Banks," she explains, "but it creates a great community spirit. We support the fishing tournaments in our area."

After the recent Nags Head Surf Fishing Tournament, Ply did some figuring to determine the impact this tournament had on the area. Of the 500 fishermen who entered the tournament, 52 percent were not local and 33 percent were from out of state. With a conservative estimate of $60 a day for expenses for these people (lodging, meals, etc.), she figured the three-day tournament added $50,000 to the community's coffers. And, this was a very low estimate, she explains, because it doesn't account for the numbers of fishermen who stayed longer than three days and brought their families and friends.

Some communities actually sponsor a tournament, as is the case with the U. S. Open King Mackerel Tournament held in the fall. Backed and promoted by the Southport-Oak Island Chamber of Commerce, this tournament is not meant to make money, explains chairman John Barbee. "We basically want to bring people into the area when business is usually slow, the Indian summer days," he says. He figures at least $200,000 worth of business was brought in during the recent tournament. And this also is a conservative estimate, Barbee explains.

Pursuing a hobby for competition and camaraderie

Photo by Cassie Griffin



For Gary Oliver, fishing is both his profession and pleasure

Ask any tournament fisherman why he fishes competitively, and the first thing he'll say is he just loves to fish. Fishing isn't just a weekend hobby with this breed because almost all tournament fishermen have fished for years and fish regularly, year-round. But, fishermen have their reasons to spend so much time and money pursuing their hobby.

For some, like Gene Carnes, fishing is his profession. Carnes is a professional guide and captain of the boat Coquina in Wilmington. "I've been tournament fishing up and down the coast for fifteen years," he says, "from the Bahamas to Canada and in every conceivable type of tournament put on. This is the way I make my living, and I don't have any other job, but to fish."

Even if his surroundings are plush and the free lifestyle exciting, there is a lot of work involved in his profession. In addition to the routine maintenance and preparations each day, Carnes is responsible for entertaining the tournament team on board and guiding them to spots that can produce winning fish.

Is it luck or experience that makes a winning tournament fisherman? "Myself, I believe it's more luck," he answers. "Naturally, experience plays a great part in it, but a man that's never even been fishing before can go out and catch a fish. However, a man that's got some experience will, over a period of time, more than likely produce more winning catches than a man that's just plain lucky."

"One aspect of tournament fishing," Carnes says, "is to bring a crowd of people together to enjoy each other's company. There are parties and plenty of socializing all during the tournament. I guess it's the camaraderie I like best about tournaments," he explains, "where everybody over the years has become very close friends and enjoys seeing one another during the season."

Gary Oliver of Manteo agrees that there is some luck, especially "luck in the draw" of positions, in surf fishing competition. But then, he's not telling what his team, the Outer Banks Sportfishers, used for bait to win the Cape Hatteras Anglers Club Surf Fishing Tournament two years in a row. Oliver also makes fishing his profession. In addition to owning a pier and two bait and tackle shops, he writes a weekly fishing report for the *Outer Banks Current* and is the local representative for the National Marine Fisheries Service.

Finesse, Oliver insists, is the secret to winning. "Being able to read the water," he says, "is what makes a good surf fisherman. I ride the beach before a tournament to get a feel for the fish around and decide what bait and rigs to use. Conditions can change in one wind switch, so you have to be prepared for everything."

Tournaments are almost like a holiday, he declares. "The guys I fish with on my team and the people in the club are a lot of fun to be around," Oliver says. "Not only is the competition a real challenge, but I look forward to tournament time. It's like a vacation in the fall."

The prestige of winning is one reason Ken McGee of Wilmington enters mackerel and marlin tournaments, even though he admits that almost everybody loses money tournament fishing. McGee will do almost anything to compete in the tournaments and has found an economical way to satisfy his competitive nature and love of fishing. He owns a small 23-foot boat, catches his own bait, occasionally buys used equipment, rigs his own lines, and has two friends who are also experienced fishermen on his boat with him. Sometimes, he will even

Continued on next page

stay out overnight, saving fuel with one less trip to and from the marina. On these overnighters, he and his crew members will bottom fish for grouper and snapper, which they sell back at the marina, often clearing as much as $300 to $400.

And, if the competition isn't enough for him, McGee is also involved in the organization of the Cape Fear Marlin Tournament as chairman of the Special Awards Committee and as treasurer of the New Hanover Fishing Club (which claims to be America's largest fishing club). He says the fellowship is also a very important reason he is so active in competitive fishing. "When all of us get out on the water, everybody kinda unites in a common cause. If somebody gets in trouble, no matter how competitive, regardless of what's at stake, you go to them. It's a tremendous feeling of fellowship, and you'll find that in all the tournaments."

Changes in The rules

Tournament fishing hasn't always been well-received by the public. Residents of many coastal communities can recall when hundreds and thousands of pounds of fish caught during competition were dumped overboard and left to rot. But there have been some rule changes in recent years to counter the bad publicity.

Leon Abbas, Sea Grant's recreation specialist, credits this reorganization to a change in society's attitudes. "People aren't as tolerant of waste," he says, "so tournaments are changing to reflect this attitude, Fishermen are also becoming more and more aware that you can't keep pulling fish out of the ocean. There is a growing appreciation," he explains, "that these fish are valuable, a resource that you can't keep on destroying."

The two recent rule changes in tournaments, Abbas says, are a tendency towards more releases and better utilization of the fish killed. In mackerel and billfish competition, prizes for live releases are becoming more common and appealing, although the big money still involves a kill.

Photo by John R. Rottet

Hanging the catch at the 1980 Hatteras Marlin Tournament

Abbas contends that this practice satisfies both the competitors and spectators who want to see the winning fish. A 700-pound marlin can draw a sizeable crowd.

Selling or giving away the kill has also become more common in recent years. A healthy market for seafood, especially the prized king mackerel, is the reason for better handling and utilization of the fish in all three types of tournaments. And, when size makes the kill too difficult to market, the fish is either given to a scientific institution for research or hauled off and buried. Some fish are even returned to the sea when they are sold for crab bait.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings and workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

For generations, the Japanese have been raising eels. And they still know more about it than anyone else. A measure of their expertise rubbed off on some North Carolina scientists and students during October, when Shigeru Arai, a Japanese authority on eel culture, visited here for 10 days.

Arai came at the invitation of Bill Rickards, director of Sea Grant's eel culture project in Aurora. Rickards and Arai met in Japan in 1978, when both were attending a meeting of a joint U.S. and Japanese committee on aquaculture.

The reason for Arai's visit was twofold: to observe North Carolina's growing aquaculture projects, and to share his knowledge with his American colleagues. Arai visited Sea Grant's eel farm and other aquaculture sites, and conducted a seminar on aquaculture at East Carolina University (ECU).

Arai also spent time with Margie Lee Gallagher, an eel nutritionist at ECU. Gallagher is conducting a Sea Grant study designed to find out what and how to feed pond-raised eels. She is looking for the diet that will promote their growth and good health under the stress of culture. Arai showed Gallagher ways to select fish for her samples and made other suggestions.

According to Gallagher: "It's basically a problem of getting a wild animal to eat an artificial food. Arai's advice was a big help."

Both Rickards and Gallagher expect to follow up Arai's visit with more of the same cooperation. They believe this kind of exchange will save time and effort, and help produce better eels for both nations.

Aquaculture—the "farming" of aquatic life—may be just on the edge of becoming big business in the United States. Congress recently passed legislation that provided research and development support for aquaculture in this country. To become eligible for some of the federal funding, North Carolina officials must develop a plan outlining the state's ability to develop aquaculture. They need to know what species would culture well in this state and how to develop aquaculture as a business.

Sea Grant Director B. J. Copeland has awarded mini-grant funds to associate director Bill Rickards and John Foster, both associated with the NCSU Eel Culture Project in Aurora. They will be gathering all the information they can about the status and potential for aquaculture in North Carolina, so state officials will have the information they need to draw up a plan.

The $10 Holding Tank is an illustrated bulletin designed to help boaters meet the new Coast Guard regulations prohibiting the disposal of untreated wastes into near shore waters. The bulletin tells how to build an inexpensive, portable holding tank designed by Spencer Rogers, Sea Grant's coastal engineering specialist. The bulletin is the first in a new Sea Grant series entitled "Blueprints." The series will offer up-to-date information and instructions to help readers solve a variety of marine and coastal problems. For a free copy of *The $10 Holding Tank*, write Sea Grant, P. O. Box 5001, Raleigh, N. C. 27650, and ask for UNC-SG-BP-01.

To Eel or Not to Eel, by Leon Abbas, an economist and Sea Grant's recreation specialist, is an economic analysis of a part-time fishing enterprise. The recently updated booklet spells out the expected investment in time and equipment, and offers other financial guidelines. The booklet is designed to be used by fishermen. For your free copy, write Sea Grant and ask for UNC-SG-77-02.

Hurry, hurry, step right up. And step they did this year at a rate of 1,000 people per hour through the Office of Marine Affairs' N.C. State Fair exhibit.

Eels were the main theme and attention-getters this year, and they came in all shapes and sizes. Panels inside the exhibit tent described eels and their habits, the NCSU Eel Culture Project in Aurora and the many uses of eels. A variety of wallets, handbags and other products made of eel skin were also on display.

For a more tangible experience, several live eels were kept in a "touch tank," and even many of the more squeamish visitors just couldn't resist the chance to "feel an eel." In addition to more live eels in a 700-gallon aquarium, there were 125 pounds of smoked eel on hand for tasting. Responses ranged from "gross" at the mere sight of the eel to "excellent" after a taste.

The eel exhibit for the fair was designed and put together by Dale Martin, exhibits coordinator at the Roanoke Island Marine Resources Center, with eels provided by the NCSU Eel Culture Project and smoked by the NCSU Seafood Laboratory in Morehead City. Supplementing the eel information were panels on the UNC Sea Grant College Program and the Marine Resources Centers.

Continued on next page

The exhibit will be rotating among the Marine Resources Centers at Roanoke Island, Bogue Banks and Fort Fisher until it is put on permanent display next year at the NCSU Eel Culture Project at Aurora.

A holiday reminder: Don't toss that Christmas tree when the festivities are over. Use it to mend a sand dune cut down by vehicles or people. Just lay the tree in a gap in the dune line, parallel to the beach and away from the surf. In windy areas, a tree can trap up to five feet of sand a year.

According to Spencer Rogers, Sea Grant's coastal engineering specialist, beach winds pick up sand as they move along. But the wind will drop its load if it meets an obstacle like the thick branches of a Christmas tree.

When you do build a dune, protect it. Plant it with a native beach grass to anchor it in place.

Trapped: hundreds of small birds in unused eel pots. According to Dennis Regan, a Sea Grant marine advisory agent on Roanoke Island, birds are entering the wire pots, which are often left stacked by a shed or near the docks, to eat scrap fish left in the bait wells. Once inside, many birds cannot escape, and die. Regan is asking eel fishermen to clean out their bait wells and to stack their eel pots so that pot entrances are not open to the birds.

Many North Carolina fishermen fish not only the offshore waters of our state, but also the waters off other states. So management decisions made in other areas affect our fishermen. That's why John Maiolo, an East Carolina University sociologist, was given Sea Grant mini-grant funds to study the impact of a New England sea scallop fishery management plan on North Carolina fishermen.

The plan, proposed by the New England Fishery Management Council, would prevent fishermen from harvesting sea scallops smaller than 30 meats per pound. The limitations may make the trip to New England unprofitable for North Carolina fishermen, but that's what Maiolo needs to find out. He will be questioning fishermen and processors about their involvement in New England scalloping.

Another Sea Grant mini-grant was awarded to Hans W. Paerl, a researcher at the University of North Carolina Institute of Marine Science in Morehead City. He will be trying to come up with ways to use *Codium*, a nuisance seaweed that grows abundantly on oyster shells. Paerl believes that *Codium* may be used as a fertilizer or an additive in paint and other products. If Paerl can come up with a productive use for *Codium*, it may become economically feasible to harvest the weed, providing oystermen with some extra income.

I want Coastwatch

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant. Box 5001, Raleigh, N.C. 27650.

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COAST WATCH

Photo by Steve Murray

At the eel farm, hundreds of baby eels squirm toward a meal specially concocted to make them grow fat and healthy

Mapping floods, Weighing waves

The North Carolina coast is a complex creature, but one worthy of understanding. From the barrier islands to the estuaries, from the seafood industry to the marina business, questions constantly crop up about our coast. Some of the answers are simple, but others require years of research.

In an attempt to mesh the need for greater use of coastal resources with a respect for environmental needs, Sea Grant has funded 26 research, education and advisory services projects by researchers at seven universities. Twelve projects are new to the program while 14 are continuing.

Of all the forces nature brings to bear in coastal North Carolina, none is more dramatic than a hurricane. But not since Hazel in 1954 has our coast felt the brutal winds and surging floodwaters of a major storm. The threat of a hurricane makes communities and officials apprehensive: When a hurricane does strike, what will it destroy?

A new Sea Grant study beginning this year is to pinpoint areas in coastal North Carolina that are especially vulnerable during storms. T. C. Gopalakrishnan, an associate professor of marine science at North Carolina State University (NCSU), has already begun studying data from Hazel. He will use the data to project the extent and impact of floodwaters under

Continued on next page

Photo by Steve Murray

Dense coastal development, like this stretch in Long Beach, poses a host of problems for planners

various conditions. Beach communities and other populated coastal areas would be "mapped." The goal is to develop a numerical model that would predict, given the position and characteristics of an approaching hurricane, what coastal areas would likely be submerged.

The information will have several direct applications. Communities will be able to use it to plan evacuation routes for their citizens. It will help state and local officials strengthen building codes and land-use management plans. And it will be useful in the application of federal flood insurance regulations.

The research will fit nicely into Sea Grant's effort to create an awareness of weather hazards in coastal areas. This year, a coastal weather awareness specialist will join the ranks of Sea Grant's Marine Advisory Service. Working with the National Weather Service, the specialist will focus research results and help communities plan ways to protect the lives and property of their residents.

Less dramatic but perhaps just as serious as hurricane flooding is the problem of septic tanks in sandy coastal soils. On the Outer Banks, where the water table is high and the soils are porous, it is difficult to find a site on which a conventional septic system works. Too often, such systems fail, allowing effluent to spoil groundwater or to seep into sounds and estuaries, where it contaminates fishing grounds.

Because ocean outfalls and sewage treatment plants are usually too expensive for small communities, preventing the use of a septic tank has meant preventing the development of a property in many areas.

This year and next, a Sea Grant research team with a record of success on other difficult soils will study the problems and, perhaps, prescribe some solutions.

The study will follow up on work done by Bobby Carlile of the NCSU soil science department. With Sea Grant support, Carlile has developed two modified septic systems—one built into a mound and the other employing a low-pressure pump—that work effectively in many areas where conventional systems have failed because of poor soils. Carlile's associate, Craig Cogger of NCSU, will set up a demonstration site on the southern North Carolina coast and test both modified systems to see how each performs in the coarse sands of barrier islands. Cogger will get help from Mark Sobsey of the University of North Carolina at Chapel Hill (UNC-CH), who has been conducting a Sea Grant project on enteric viruses in shellfish.

Coastal management officials are waiting for the study to help them make sound judgments about development on the islands. And, if good alternatives are found, some failing systems might be replaced, protecting coastal waters from at least some of the pollution from island communities.

Dealing with any complex coastal issue—including such things as hurricane preparedness and sewage treatment—usually involves at least one legal or public-policy angle.

Finding expertise in coastal law and planning is a problem, not only for the state's Office of Coastal Management, but also for many coastal communities. There is simply more legal and planning work than there are people trained to do it. Much of this work is research, and that's an area in which Sea Grant can offer help.

Sea Grant is funding a new two-year project that will provide both research and training. Graduate students from two state campuses, the University of North Carolina at Chapel Hill (UNC-CH) and North Carolina Central University (NCCU), will be recruited to work on coastal issues. Their efforts will be directed by David Brower, of the Center for Urban and Regional Studies at UNC-CH, and Tom Earnhardt associate professor of law at NCCU.

The idea of involving students in such work is not new. The first Sea Grant project in coastal law and planning was begun in 1971. Students from that program, and from the other programs that followed, have gone on to become coastal policy-makers active in a number of state offices.

This year's project has several goals: to provide some of the research and scholarship coastal management officials need to set effective policy; to interest and train talented law and public-policy students in the growing field of coastal and marine planning and law; and to help leaders keep up-to-date on the issues they face.

As their colleagues probe the soils, contours and issues of coastal North Carolina, two teams of researchers from NCSU will continue a pair of projects aimed at measuring and predicting the movement of its waters.

Ernie Knowles and Bob Weisberg are continuing a search begun in 1979 for ways of predicting how the Gulf Stream affects wave energy at the coast. Much of their effort so far has been invested in improving and testing the sophisticated gear required to measure wave size, shape and energy. This year and next, the team plans to use the equipment to pull together the data they need to tailor standard wave-prediction models to North Carolina. Such information could be applied to a host of coastal problems, from the design of coastal structures to the control of beach erosion.

The sea's energy runs deeper than surface waves. Currents carry sand, nutrients, pollution, marine life and energy in the nearshore waters. Measuring and understanding those currents is critical to the management of many coastal resources.

In 1979 and 1980, Tom Curtin and Yates Sorrell developed the tools to measure and describe those currents. Current meters have been available for some time, but they were designed for deep water and were so expensive that scientists could not use enough of them to adequately measure nearshore processes. Curtin and Sorrell's gear has the advantage of being relatively inexpensive, and yet accurate. This year, the team plans to moor several of the new meters and begin collecting data.

If the team is successful, it will be possible for scientists to trace nutrients, pollution, and sediments, and define the physical environment of the marine life.

An epidemic of marine education

Beaches, marshes, islands, estuaries and the sea—there is no more stimulating setting or subject for learning than coastal North Carolina. Just ask a child whose teacher has led a field trip there.

For some time, Sea Grant's marine education specialist, Lundie Mauldin, has worked to infuse marine studies into the curricula of the state's public schools. This year, Sea Grant will support five innovative projects that will reaffirm North Carolina's national leadership in marine education.

—By 1985, about 80,000 young people in the state's 4-H programs will have had exposure to marine and coastal science, thanks to a new Sea Grant program organized by Donald Stormer and Dalton Proctor of the N.C. Agricultural Extension Service that will train 4-H extension leaders and volunteers, and develop study materials for youth.

Because of the project, coastal resources will be stressed in 4-H curricula, volunteer-training workshops and 4-H camps. The entire effort is aimed at instilling in some of the state's future leaders a working knowledge of coastal resources.

—This year Sea Grant will be bringing more of the coast to the classroom. With a video system to be shared between the Marine Resources Centers, Sea Grant and center staff can tape workshops and programs for later use in the classroom. Neal Conoley, project coordinator and education specialist with the N.C. Office of Marine Affairs, says the video system can also be used to share programs between the centers.

—Three interns have successfully completed a program begun last year to train leaders in marine education. The project, directed by Carolyn Hampton of ECU, schools future educators in the issues and the natural environment of coastal North Carolina. This year, several more students working towards advanced degrees in education will use internships in institutions like the N. C. Marine Resources Centers to develop new educational materials and teaching strategies.

—In its fellowship program this year, Sea Grant will offer support to five undergraduate students, from primarily black or American Indian colleges, who will participate in marine studies. Also, three doctoral candidates working in marine science will use Sea Grant fellowships to further their studies.

—Beyond the classroom, the need for education is especially keen. A program of continuing education for commercial fishermen, led by Jim McGee of ECU, last year reached hundreds of fishermen with information about new gear, safety practices and navigation. This year, more workshops, classes and presentations will cover such areas as financial management, new technology and practical meteorology.

—While these projects try to fill the immediate need for marine education, another Sea Grant research team is trying to anticipate the future need for skills and education in another area—the seafood industry. Nozar Hashemzadeh and Michael Simmons, both of North Carolina A&T State University, spent last year learning about the industry's needs for manpower. They have found that seafood plants, as they modernize, are hampered by a shortage of skilled labor. The team is compiling a profile of the state's seafood industry, including an analysis of its labor requirements.

Tracing the secrets of shells, fish and sportsmen

Among the natural resources concentrated in North Carolina's estuaries, recreational fishing ranks as one of the most important. This year, a Sea Grant research team will study the resource by going straight to the people who enjoy it—the people who spend their leisure hours fishing the state's sounds.

Following up last year's study of offshore fishing and tournament fishing, Peter Fricke, an ECU sociologist, Leon Abbas, Sea Grant's recreational and economic specialist, and James Sabella, a University of North Carolina at Wilmington anthropologist, will be conducting a similar socio-economic study of sound fishing.

They will be surveying fishermen to find out who fishes in the sounds, where they are from, how much they spend in local businesses while they're fishing and what type of fish they are hoping to reel in. The researchers feel this type of information can be used by local and regional planners to provide for things like boat ramps and fishing access areas as well as for more complicated things like zoning for economic activity.

In another part of the study, Fricke, Abbas and Sabella will be paying particular attention to the recreational and commercial striped bass fishery. There has been growing national concern over the decline of striped bass in eastern United States sounds. This study, along with others in Maryland and Virginia, will attempt to answer some questions needed for better management and revitalization of the fishery.

Striped bass aren't the only fish on the decline in North Carolina sounds. Commercial catches of river herring are also on the downswing. Past declines were attributed to intense offshore fishing of river herring by foreign vessels. But controls implemented by the 200-mile limit in 1975 lessened offshore fishing pressure. The river herring catches, however, did not respond and landings remain low. Scientists now suspect the reason for fewer river herring may lie elsewhere.

Bob Sniffen, an ECU researcher, will be examining larval and juvenile river herring in the Albemarle Sound system, the state's primary nursery for these fishes. He will be studying the habitat needs of the tiny river herring soon after they are spawned along the edges of streams and rivers. He wants to determine what link exists between habitat conditions during the larval and juvenile stages and river herring adult abundance later.

In particular, Sniffen will be looking at river herring in the Chowan River system, where nutrient pollution has caused massive blue-green algae blooms and reduced oxygen levels in the river. Over 50 percent of the state's river herring landings come from the Chowan River. Sniffen will be examining the effects of the nutrient pollution on the young river herring.

Sniffen will be coordinating his Sea Grant work with an Environmental Protection Agency grant he received last year. With that grant he is studying the role of flood plains. Sniffen says his work will be used by Marine Fisheries to develop a management scheme for river herring later this decade.

With five major research facilities in Carteret County, there is a wealth of research on the nearby Newport River estuarine system. But the trouble comes in finding the results of that research. It is scattered among the files and libraries of numerous research organizations.

John Costlow and William Kirby-Smith, two scientists at the Duke Marine Laboratory at Beaufort, are going to put together an annotated bibliography of past, current and proposed research that is specifically related to the Newport River estuarine system. The bibliography will be particularly helpful to researchers planning new research in the Newport system and in similar systems along the East Coast. Coastal managers and planners can use the bibliography as a guide for seeking information needed to make management decisions.

As a second part of their project, Costlow and Kirby-Smith will characterize the Newport River system, describing its hydrology, geology, fisheries, biology and ecology. Scien-

Photo by John Rottet

Livelihoods rise and fall with the health of estuaries tists can use this characterization as a base in developing plans for managing the state's estuaries and to compare the Newport system to other estuarine systems in this state and along the East Coast.

While Costlow and Kirby-Smith are digging through files and libraries, Mark Sobsey, a UNC-CH researcher, will be digging for clams and oysters. Sobsey will be continuing his Sea Grant work, begun last year, to study virally contaminated oysters and clams. He has already found that oysters relayed from polluted waters to clean waters flush harmful viruses from their bodies rapidly during winter, spring and late fall. But the oysters do not purge the viruses very well during summer and early fall.

This year Sobsey will be trying to find out why the oysters do not cleanse themselves as readily during warm weather. To find out this information, Sobsey will be examing where the viruses settle in the oyster's body. Sobsey will also continue to gather information on the distribution and survival rate of viruses and bacteria in shellfish, water and sediment contaminated by wastewater. Sobsey's project will be useful in evaluating current bacteriological standards for shellfish contamination and perhaps provide better ways of determining shellfish contamination in the future.

Shellfish also figure in a Sea Grant study being conducted by Charles Peterson, of the UNC-CH Institute of Marine Sciences, and Peter Fricke, who will continue their work with hard clams. Last year, Peterson learned that North Carolina hard clams, like trees, add a growth line in their shells every year. With this information, Peterson will know how long it takes a clam to reach a harvestable size. Peterson will also be continuing his harvesting tests. In these experiments, he will be comparing the biological effects of clam kicking to the more traditional means of harvesting, like clam raking.

Fricke will be conducting the sociological part of the clam study. He will be surveying and interviewing fishermen so that he can compare the economic benefits and costs of clam kicking to those of clam raking. He also will be seeking to learn why some groups of fishermen adopted clam kicking while others did not. And, more generally, he will be trying to determine fishermen's attitudes toward management policies.

Another continuing project concerned with fishermen's attitudes and beliefs about the fishery and its management is John Maiolo and John Bort's project about the shrimp fishery. Maiolo and Bort, two ECU sociologists, have been gathering historical information on the shrimp fishery to give managers a better insight into a fishery steeped in tradition. Maiolo and Bort also have been conducting interviews with shrimp fishermen and marketers to see how traditions, community ties and occupational options of the fishermen affect the fishery.

Better eating for the edible eel

Since the original funding of Sea Grant in 1970, money has been allocated for aquaculture studies. One of Sea Grant's new projects this year proposes to encourage development of an aquaculture industry in North Carolina through research and demonstration at the Aquaculture Demonstration Project in Aurora.

William L. Rickards, associate director of UNC Sea Grant, says the project will provide aquaculture information on the American eel, coho salmon and rainbow trout. In response to one request, project personnel will be working in cooperation with Texasgulf in Aurora to develop fish farming techniques for salmon and trout during the summer months. Requests have also generated the need to establish a blue crab shedding demonstration at the facility. There are currently only a few crab shedders in North Carolina, but a high demand for softshell crabs indicates the time is right for this new seafood business.

The last part of this project will include aquaculture advisory services to meet the many requests and bring the research to the people. A reference library, demonstrations and cooperation with other agencies and active aquaculturists are some of the means this project will use to encourage development of new aquaculture businesses in the state.

To successfully raise any species in a culture system, a nutritional diet is one of the primary requirements. But, this one factor has been the major drawback in American eel culture operations in the United States. In Europe and Japan, where there is a strong market for eels, a nutritional diet for the European eel and Japanese eel has been established through research. One new Sea Grant project intends to do the same this year for the American eel.

In Europe and Japan, eels are widely used as a food source and that demand has increased annually. North Carolina has been harvesting and shipping its wild eels to these markets since 1972, but the long-term demand can't depend on just wild eel sources. The establishment of an eel industry can meet these demands if a low-cost, nutritional feed can be developed. At present, there is no inexpensive commercial feed being produced for the American eel.

Margie Lee Gallagher, assistant professor of home economics at ECU, is researching the nutritional requirements of the American eel. By studying the eel's body composition, she will develop the proper protein, fat, carbohydrate and energy levels necessary for an artificial diet and good growth under culture conditions.

When setting opening dates for shellfishing in the state, the Division of Marine Fisheries (DMF) often runs into conflicts. It may be the right time to open clam season, but what effect will certain harvesting techniques, such as clam kicking, have on young scallops developing in the same area. Holding the opening of shrimp season is sometimes good for shrimpers because larger shrimp bring higher prices. But, often this delay means more shrimp are migrating out of the estuary. What effect does crab trawling have on oyster beds that are being built up? What works for one species is often bad for another. So, where do you get the information to make these decisions?

Jim Easley, Thomas Johnson and Frank Benford at NCSU will be compiling the necessary information and developing a set of models to help DMF decide on the timing in such

Continued on next page

management questions. In this project, basic biological information will be collected on bay scallops, clams, New River shrimp and crabs in the Pamlico Sound bays. This information will be combined with economic data including weekly prices, market demands and past seasonal patterns in harvesting. With both the biological and economical aspects considered, a system will be developed to answer these questions with relation to each individual species and in overlapping situations, such as clams and scallops.

In 1981, this team of researchers will be setting up a model for each species mentioned and working with DMF to determine fishery management problems and conflicts. Once in operation in 1982, updated information can be added.

Seafood harvest and processing is a healthy industry in coastal North Carolina. In 1979, total landings amounted to $60 million. To keep up with technological advances and improve economic yield, Sea Grant researchers will be continuing research on four projects.

Don Hamann, Tyre Lanier and T. S. Lin of the food science department at NCSU will be experimenting with new minced fish products this year. Underutilized species, such as spot, croaker and mullet, are washed and minced to produce a fish meat called surimi. When combined and processed with shellfish, like shrimp or crabmeat, the end product is not only delicious, but lower in cost. And, with ever increasing seafood prices, an inexpensive alternative is welcomed by people who can't afford, but still want, seafood on their tables.

During 1980, the researchers received very high marks from several taste panels which sampled surimi shrimp fried, in salads, casseroles and creole. Seafood processors are also interested in the highly nutritional seafood product for fabricated prepared seafoods. New work in this project will include refining processing techniques, developing new food products, and experimenting with new fish species for surimi.

In related research, Lanier, H. M. Hassan and Frank Thomas have been experimenting with ways to get fresh fish to inlands markets. To achieve this goal, the researchers have been perfecting a method of freezing fresh fish. A frozen product that can withstand both shipping and market storage also depends upon durable and appealing packaging, a second phase of the project.

Market surveys conducted during 1980 in area supermarkets indicated customers are eager to put fresh frozen fish in their shopping carts. But, by testing a variety of packaging techniques, it was determined that appearance is the selling factor in determining whether the consumer picks up the fish or not. Continuing research will include more experimentation in freezing and packaging, including more market tests, to produce a product with a longer shelf life and appeal.

Waste created in seafood processing plants is and always will be a major problem. Treatment is expensive and often ignored by small seafood businesses along the coast. But, Allen Chao and Jason Shih of NCSU have found a way to take waste and create a valuable product from it.

Using techniques developed for poultry waste treatment, they devised an ultrafiltration process in 1980 which traps valuable nutrients. Water and small molecules which pass through the filter are cleaned, and the water can be re-used. The trapped nutrients also have potential for use as supplements in animal feed.

Aquaculture is also respresented in a continuing project. Researchers Howard Kerby and Mel Huish of NCSU have developed a successful culture for raising hybrids from striped bass X white bass and striped bass X white perch. Begun in 1979, this project has demonstrated that larval bass can be produced in large numbers in tanks and ponds similar to those used at the Aquaculture Demonstration Project.

Photo by J. Foster Scott

From the ocean to the table, seafood is vital to the coastal economy.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant office in Raleigh (919/737-2454).

Cold weather isn't enough to keep some fishermen in on a blustery day, but frozen sounds are. Days of record low temperatures in January froze sounds three to four feet thick along the Outer Banks, keeping all boats docked for several days and fishermen in for a winter break.

John McClain of the National Weather Service in Raleigh said this winter has been cold, "but not that cold. The winter of '76 and '77," he explained "was the coldest in North Carolina since we started keeping records." According to Jay Hull of the Cape Hatteras National Weather Service, "During that chilly winter, there were long strings of days below freezing with ice, blown up on the beach by wind, eight to ten feet high. Still, January has been a cold month with below normal temperatures."

Salinity is a prime factor in sounds freezing. Bob Hines, Sea Grant marine advisory agent at Bogue Banks, says the sounds are not as salty as the ocean and will freeze first. "As salinity goes up," he says, "the freezing point goes down. Average sound temperatures during this cold period were 34°F (1°C). The freezing point for ocean water is approximately 28°F (-2°C)." 2°C)."

When the water gets colder, fish move to warmer areas. But, thousands of young croaker in Pamlico Sound got caught in the sound and died in the freezing water. According to Bob Pittman of the Division of Marine Fisheries, "This was not a tremendous loss in relation to the annual harvest, but still a significant loss. Fishermen were scooping up one-tenth of one percent of the dead fish, but they are not a marketable size."

Pittman is concerned that more of the extreme cold could affect the pink shrimp population which is overwintering now. Pink shrimp account for only 10 to 20 percent of North Carolina's total shrimp harvest, but Carteret and Onslow counties are very dependent on this species. "It's possible," Pittman explains, "that we could have a high mortality rate if these cold temperatures continue." The pink shrimp and oyster populations were in danger the winter of 1976-77.

The recent cold spell has the Coast Guard worried, too. Many aids-to-navigation, especially between Oregon Inlet and Roanoke Sound, were ripped out by the ice. QMT Richard Brady of the Cape Hatteras Coast Guard Station says, "A lot of aids are missing, destroyed or off location, and boaters should exercise extreme caution. A broadcast notice to mariners will be aired continuously until the aids are replaced."

Brady says replacing the aids will take some time. There is an ice-breaking vessel, the Chokeberry, assigned to the Hatteras area. But, it is now working in the Chesapeake Bay where there has been even more severe winter weather.

Since so many of our readers have expressed an interest in our Harkers Island issues, *Coastwatch* thought you might like to know about a program being aired on UNC-TV this month. "The Peggy Rose," a 30-minute program on the Rose Brothers Boat Works, will be broadcast on all UNC-TV stations February 9 at 10:30 p.m. and February 15 at 3:30 p.m.

Produced and directed by Woody Woodward, the documentary follows James and Earl Rose building a 55-foot sportfishing boat from 1977-78. Completed last October, "The Peggy Rose" was a massive editing project of over 25 hours of videotape shot at the Harkers Island boat works. Woodward's production was the result of an artist-in-residence grant at UNC-TV funded by the Corporation for Public Broadcasting and the National Endowment of the Arts.

Over a thousand students entered a recent poster contest celebrating 1980 Year of the Coast. Sponsored by Sea Grant, the North Carolina Marine Resources Centers and the Department of Public Instruction, the statewide contest entries were judged in four age categories by the three centers and the Sea Grant office.

Entries included seascapes, lighthouses and coastal animals in crayon, pastels, pen and ink, acrylics and mixed media. Winners were awarded a specially designed certificate and a marine education program, called "Sea Day," for their classes or schools.

Winners in grades K-3 were: Stephanie Krolick (first place), Kitty Hawk Elementary, Kill Devil Hills; Justin Cooper (runner-up), Forest Hills Elementary, Wilmington; and Rockridge 2nd Grade School (class poster runner-up), Cleo Taylor, teacher, Wilson. Winners in grades 4-6 were: Tommy Southern (first place), Summer Middle School, Greensboro; Cathy Scarborough (runner-up), Ocracoke School, Ocracoke; and Leslie Ashfield (runner-up), Welcome School, Welcome.

Winners in grades 7-9 were: Wylie Whitehurst (first place), Ocracoke School, Ocracoke; Denise Lavertz (runner-up), Wiley School, Winston-Salem; and David Cagle (runner-up), East Lee Junior High School, Sanford. Winners in grades 10-12 were: Robert Stephens (first place), Weaver

Continued on next page

Educational Center, Greensboro; Steve Warner (runner-up), Washington High School, Washington; and Karen Forehand, J.H. Rose High School, Greenville.

Fishermen and hunters ply coastal waters even during the winter. But rough seas can cause a boat to capsize and winter's cold water can be a killer.

When a person is thrown into cold water, nearby tissues begin to cool very fast. These tissues cool the blood flowing through arms and legs which in turn begins to cool the blood in the inner body. It takes 10 to 15 minutes in water below 70°F before the temperature of the heart and brain begin to drop. When the body temperature falls below 98.6°F, a condition called hypothermia exists.

First you shiver, then you lose manual dexterity and muscle rigidity. As cooler and cooler blood circulates to the brain, mental confusion occurs. When the core body temperature falls below 90°F, the victim becomes unconscious. At a core temperature of 85°F, heart failure occurs.

Your chance of survival in cold water depends on many factors. Conserve body heat as much as possible. Do not swim. A person will cool 35 percent faster by swimming. Keep your head out of the water and adopt the heat escape lessening posture (HELP). To assume this posture, ball up in a fetal position. This is possible, however, only if you are wearing a personal flotation device. If there is more than one person in the water huddle together. Most boats will float even when capsized. Try to get in or on the boat to get out of the water.

If you rescue a hypothermia victim, rewarm him or her carefully. Do not warm the arms and legs. This can cause cold stagnant blood to rush to the core of the body, dropping the body temperature below a level that will sustain life.

Move the victim to shelter and warmth as soon as possible. Remove all the wet clothing. Apply heat to the head, neck, sides and groin with warm, moist towels, hot water bottles or heated blankets. It is best to lay the victim on a hard flat surface, should cardiopulmonary resuscitation be needed.

Another way to warm a hypothermia victim is for rescuers to remove their own clothing, using their body warmth to warm the victim's unclothed body. A blanket or sleeping bag should cover the victim and rescuer to conserve heat.

In cases of mild hypothermia, dry clothing and shelter may be all that is needed. But all hypothermia victims should be seen by a doctor.

Even if a victim appears drowned, administer heart massage and mouth-to-mouth resuscitation. Cold water drowning victims have a good chance of revival.

As inflation takes more out of your pocketbook and puts less in your grocery bag, economical meals become a necessity. One aid to good menu-planning is Sea Grant's flyer, *Fish Flakes: seafood stretchers*.

High in protein, fish flakes can be used as a low-fat extender, flavor enhancer or meat substitute in a variety of dishes. Any fish, including less popular, inexpensive kinds, can be flaked in the six simple steps explained in the flyer. And, the final product is good in casseroles, salads, chowders or sauces. Recipes are given for seafood pizza sauce, stuffed clams, stuffed scallops and crab imperial.

To obtain a free copy, write Sea Grant, Box 5001, Raleigh, North Carolina 27650. Ask for UNC-SG-79-01.

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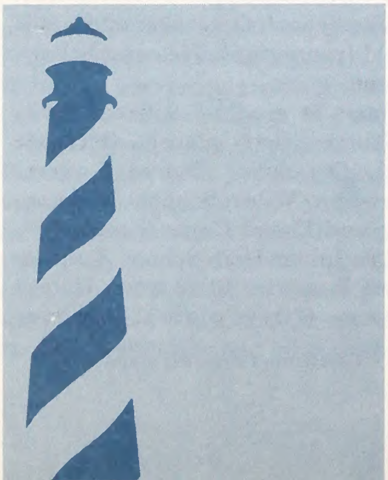

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COASTWATCH

They all laughed when Cap'n Briggs went sailing

Just try to tell a hardworking commercial fisherman, supporting a $100,000 mortgage and a ton of gear, that he needs a sailboat. Tell him to "let the wind supply the horsepower."

He'll suspect a cologne-scented bureaucrat has been hatching memos again. Or, he'll laugh the whole thing off as a joke.

And that is exactly the way Captain Lane Briggs' career as a sailing waterman began— as a joke. Briggs is a native of North Carolina's mountains who says he knew he'd spend his life on the water "the first time I ever saw the sun rise over Wrightsville Beach." Since that morning, Briggs has put in 30 years as a fisherman, tugboat captain and professional waterman.

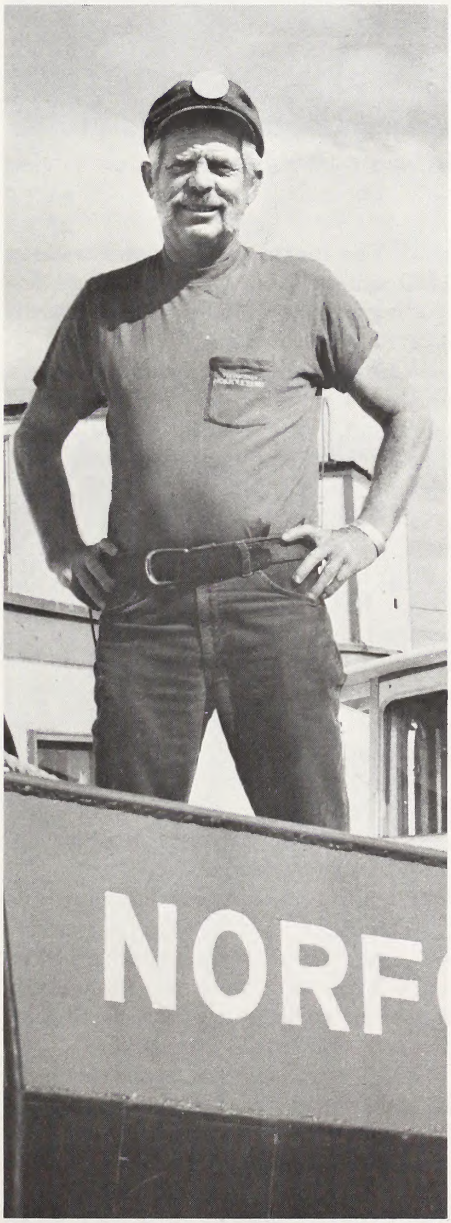
The joke? It began in 1975, when Briggs decided to throw a dockside crabs-and-beer blast, featuring a pre-party sailboat race.

"I wanted all the people around the dock to join in," Briggs says, "so I made a rule: 'If you want the crabs and beer, you have to race a sailboat.' "

That sounded fair enough until someone pointed out that Captain Lane Briggs did not own a sailboat. Briggs' company, Rebel Marine, does a lot of tugboat and salvage work out of Norfolk, Va., with some commercial fishing on the side. You don't need a sailboat for that sort of thing.

But Briggs is a sport, so he went to work on the *Steel Rebel*, his tug.

"It all started as just sort of a prank," he says. "I'd salvaged an old mast and some stuff, and just rigged up a squaresail on my boom, and also added a jib. . ."


Lane Briggs aboard his tug

The *Steel Rebel* was not the world's loveliest sailboat. For cloth, the crew hoisted an old parachute, a tablecloth and a few other odds and ends.

"You've never seen anything more peculiar than a tugboat rigged for sail," says Kathy Hill, Rebel's office manager and a member of the crew. "We ran up everything but the cook's underwear."

The *Steel Rebel* wallowed through the race like a sow among the swans. But she finished, with help from the diesel. The crabs and beer were fine, too.

"Then, a couple of days later, we were towing a barge on the bay," Briggs recalls. "We hadn't bothered to take down the masts and sails. We had a good breeze at our backs, and I looked down, and we were doing a full knot better than our usual speed. So I eased off the throttle and finished the job in less time with less fuel. After that, I made some adjustments and squeezed another knot out of her. We tried several different combinations of sails and rigging, and finally got to where we were going faster and using a lot less fuel."

Briggs says the gaff rig that he settled on lowered his fuel consumption about 30 percent. With a tow, it increased his speed 3.5 knots— even more on a light run. The joke was paying off, but there was still a lot of laughing on the waterfront.

"Everybody thought I was nuts for a while," Briggs says. "That was when fuel was still thirty or forty cents a gallon. Now that it's over a dollar,

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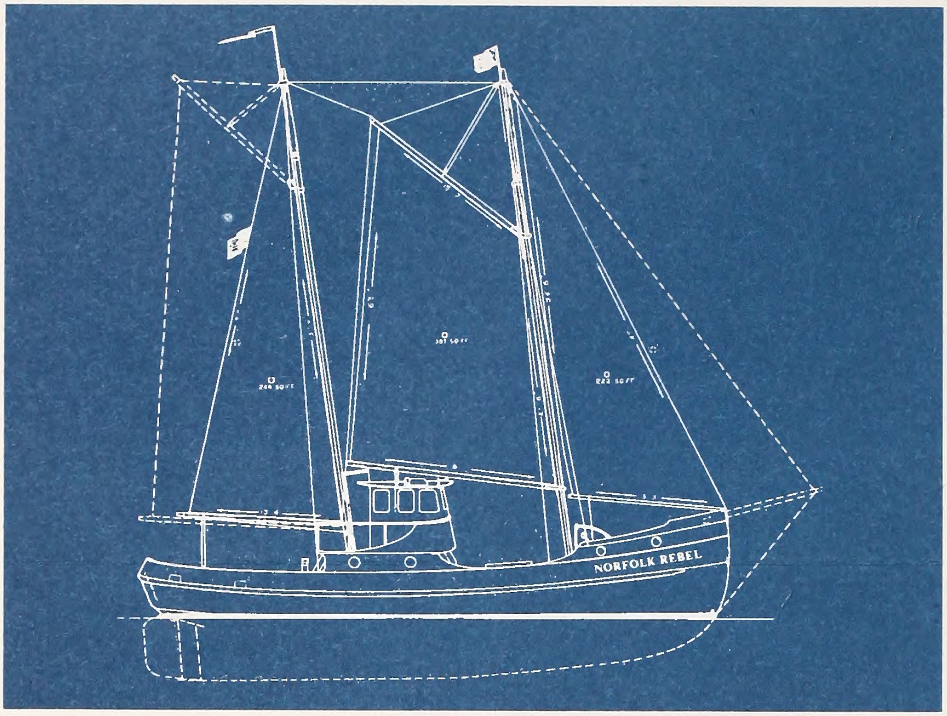


The "Tugantine," with spars or "gaffs" supporting its sails

they're taking a little more notice."

One of the people who took special notice was Merritt Walter, a naval architect from Norfolk.

"He kept telling me my boat couldn't sail, according to all the rules," Briggs says. "But since it was sailing, he said 'just think what we could do if we had a boat designed to use sail.' "

The old *Steel Rebel* did have a serious limitation: because of the hull design, she could not sail upwind. But Briggs was so convinced the wind was saving him money that he told Walter to design a new boat. The vessel was to be a diesel-powered, sail-assisted tug set up to double as a commercial fishing boat.

Financing was the first obstacle. Briggs was proposing a $300,000 risk—a newfangled design with no track record.

"The bank took a good, hard look at it, and decided to go along," Briggs says.

The keel of the new boat was laid on April Fools' Day, 1978. Not since Noah began his Ark had there been such chuckling.

The *Norfolk Rebel*, a steel-plated, light tug, 51 ft. long, was launched May 22, 1980. From the water line down, she's a sailboat, trim, with a full keel. But she also sports a 320-horse V-8, assorted electronic gear, and a fish hold. The masts are designed to carry 1200 square ft. of gaff-rigged sail, including a foresail that can be used with a retractable bowsprit.

Walters and Briggs had conceived neither a sailboat nor a conventional workboat, but a hybrid for which there was no nautical term. They coined the name "Tugantine."

"We all held our breaths during the first trials," Kathy Hill remembers. "With a new design, you never really know how it will perform. But it worked beautifully. She was practically turning on a dime, and wasn't squatting or digging in the way you might expect a sailboat to do under that kind of power."

"Our idea is using sail to assist the diesel," Briggs says. "It's not all sail. I don't think that would be practical, with the work we have to do."

There are a few disadvantages to the sails, Briggs admits. Getting under some of the bridges is a problem. For some of the deck work, the main boom has to be raised out of the way. And, Dacron sailcloth is expensive.

But Briggs says that in the first year he sailed the *Steel Rebel*, he saved enough on fuel to more than pay for the sails and rigging. He claims that he can bid a job lower and make more profit. And, the extra time devoted to sailing, he says, is counted in minutes, not hours.

Based on his experience with the first boat, Briggs expects to use the *Norfolk Rebel's* sails about 50 percent of the time he's working, saving about 40 percent on fuel.

"I feel I can sail to and from the fishing grounds, and put less running time on the engine," Briggs says. "And, if my engine breaks down, I don't have to pay somebody to tow me in. I sail home."

He'll try longlining and bottom fishing, mostly, since the longer the run, the better the efficiency under sail.

Rebel Marine has been awarded a $72,000 grant from the National Marine Fisheries Service to rig the boat with sail.

"Captain Briggs' project is the first we've supported this way," says Ed Loughlin, energy coordinator for the NMFS office in Washington, D. C. Loughlin says the government's backing for the project is based on the belief that sails offer some hope to the nation's commercial fishing fleet, which is being hounded, nearly to extinction, by the cost of energy.

Loughlin estimates that, for trawlers, about 57 cents of every dollar in overhead is spent on fuel. The average shrimper burns a gallon and a half for each pound of shrimp he hauls home, Loughlin says.

In exchange for the grant money, Briggs has agreed to formally analyze and document the performance of the boat. He has gotten help in doing so from the Sea Grant program at the Virginia Institute of Marine Science (VIMS). Sea Grant specialists at VIMS helped Briggs write the grant proposal. Part of the grant will be used to pay a researcher on the project.

"We want to see how the boat performs over a range of wind conditions and working conditions," says John Lucy, Sea Grant's marine recreation specialist at VIMS. "We also want to find the optimum ratios of diesel and sail assist, to spell out what combinations might save a fisherman the most money."

"I think you're going to see a lot more fishermen trying the idea," Briggs says of wind power. "When fuel was cheap, they just went ahead and designed boats for brute power and carrying capacity. But who can afford the fuel anymore? Sometimes, you just get to hurtin' so bad you have to change, whether you want to or not."

Along the docks, boats are idle, tempers are short

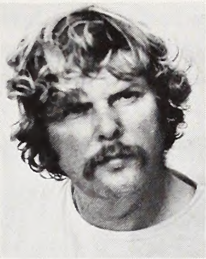
Sandy Edwards believes he has seen the commercial fishing industry hit the skids, almost overnight. Because of the leap in fuel prices, he says, fishermen are losing money, boats are tied up and idle, and tempers and patience are nearing the snapping point.

"It just restricts your movement," Edward says. "You can't go out and look for fish, because you can't afford to burn the fuel. There's a lot more guys sitting at the dock, listening to the radios, than there are out fishing. It's putting a crimp in everybody's style."

Edwards, who takes his *Raven* after snapper and grouper off Hatteras, says the once-cooperative atmosphere among the fishermen in his area is souring. Crews tend to monitor radios for word of a big catch, then race for the productive area.

"It means a hundred and fifty boats show up at one spot," he says. "There's a lot more competition and the tempers are a lot shorter."

"If I didn't have my boat paid for, I'd be looking at about one more year in business," he says. "As it is, I'm expecting to last about three. But if I were to have a major breakdown, I'd be ruined, and that's the way ninety-nine percent of the guys are."


Edwards

To save gas, fishermen are buying smaller boats and less powerful engines, Edwards says. He has had to drop his engine's cruising speed from 2000 rpms down to 1800, and what was once a three-hour trip now requires four. To squeeze more use out of the trips, some of the captains are loading a variety of gear onto their boats, just to be prepared.

"They're putting on gill nets, they're putting on net reels— they're trying to make little boats into big boats," Edwards says. "But it's just not working out."

For Edwards and others, the fuel problem is especially bitter because the prices they get for fish have not come close to keeping up with the rate of inflation.

"The other day I went out and burned a hundred gallons of fuel, at over a dollar and thirty cents a gallon, and came back with a load of trout. I got ten cents a pound for my trout. I caught thirteen pounds of trout to buy every gallon of fuel I burned."

Some of the largest boats are able to use fuel-saving devices, such as Kort nozzles and adjustable-pitch propellers— gear perfected by foreign fleets, which are accustomed to expensive energy.

UNC Sea Grant's continuing education program for commercial fishermen, coordinated by Jim McGee of East Carolina University, introduced about 150 commercial fishermen to some of these fuel-economy measures during 1980. The workshops were well-received, and more are planned for this year. (Also, the Virginia Institute of Marine Science will conduct a major conference on "fuel efficiency alternatives" later in the year).

Sail power— Will it work?

There are sailing experts. And, there are workboat experts who know horsepower and fishing. But when it comes to sail-assisted engine power, there are no real experts—only a few pioneers experimenting with a new breed of boat.

Several of these pioneers happen to be in North Carolina. Bill Hall. Bryan Blake. Paul Lockwood. So far, most of their work has been on paper. But they're beginning to get serious notice, in trade journals and national boating and fishing magazines, where their notions of sailing hulls and furling are appearing elbow-to-elbow with the latest in muscular workboats and V-8 diesels.

They point to a few successful experiments around the world: the Japanese *Shin Aitoku Maru*, a two-masted tanker with computer-operated, folding sails that save the ship's owners 50 percent on diesel fuel;

Continued on next page

Photo by Neil Caudle

Bryan Blake, boatwright, with blueprints the Hawaiian *Cornucopia*, a 60-ft. schooner that sails to and from the tuna grounds at 7½ knots; the *Norfolk Rebel*, and others, like the German-designed *DynaShips*, that have not been thoroughly tested.

"I don't see any other solution to the fix these fishermen are in," Hall says of the "sail-assist" idea. "Of course, the first thing a fisherman does is burst out laughing when you bring up the idea of sail. But unless they go this way, I'm afraid they're going to just end up sitting on the dock."

Hall spent 18 years as a naval architect in the small boat design division of the Navy Department. He also has 20 years of experience on the water, as a commercial fisherman and charter-boat operator. He works now as a project engineer for Uniflite Corporation, a yacht-building firm with a boat shop near Holly Springs.

Hall has modified the design of a 50-ft. Chesapeake Bay bugeye, the swift old sailing workhorse notorious for its ability to outrun the Maryland Oyster Police during the Chesapeake Bay oyster wars. Hall designed the craft as a sail-assisted diesel trawler. Drawings show a shallow draft, a beam tow (which Hall says would pull a 35-foot shrimp trawl), two masts and three self-furling Genoa jibs. The "jennies" are common on new sailboats over 30 ft.

"The hull shape is very good," Hall says. "It has evolved over the years to be very efficient in the water. The engine could be smaller and would not run as much. And, the difference between the cost of a big engine and a small engine would outfit the boat with sails."

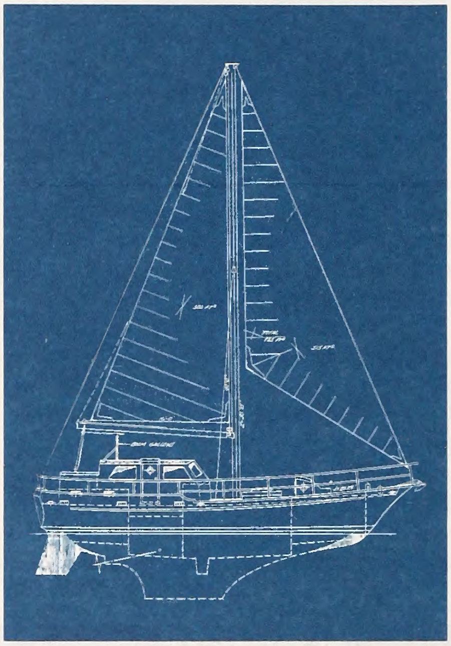
Hall points out that almost half the time, the winds off North Carolina are 15 mph or stronger.

"This boat would be efficient under sail if the wind is twelve miles per hour or above," Hall says. "I believe a fisherman could use his sails at least fifty percent of the time he was out working."

Hall figures his boat would cost about $180,000 to build, ready to sail. He admits to a business interest in the idea—he'd like to get a design commission or two. But he has also used the boat as part of his campaign to get more recognition for the fisherman's problems. He writes and publishes a newsletter, *The Professional Waterman*, and once served three years on the Maryland Sea Grant advisory board, arguing the need for research and action to help the commercial fishing industry.

"You could say I'm pretty outspoken about all this," he says. "But I know what these guys are facing. I've been down that street."

Bryan Blake is a 24-year-old boatwright from Gloucester who has gotten his boatbuilding training on the job— in James Rose's boat shop on Harkers Island, and at the Straits Railway in Gloucester. At the railway, where boats are hauled out for repair, Blake has torn down and put together everything from modern yachts to historic old sharpies and bugeyes.



CSY's yacht-turned-workboat

Blake's ambition is to build new sail-powered workboats for what he believes will be a new generation of commercial fishermen— a generation that will sail.

Like Hall, Blake reached into the past for help when he began designing his first fishing boats. He chose one he calls a "Core Sound sharpie," a classic North Carolina workboat with remarkable speed and utility. He had overhauled several old examples at the railway, and knew what went where.

"My philosophy is that the men who used to build these old boats, they have generations of experience behind them," Blake says. "If we just throw all that out the door, we're making a big mistake."

Blake is especially reverent when he speaks of sharpies built by Ambroise Fulcher, an Atlantic builder who died 30 years ago. About 50 of Fulcher's boats are still working on Core Sound. Blake's modified sharpie has materialized as two juniper-planked boats, the 20-ft. *Tortuga* and the 30-ft. *Sakonnet*. Both are adapted to use small engines when the sails are impractical.

Blake thinks that as the price of fuel goes up, fishermen will find it profitable to use sail once again. He also believes that state officials should look into incentives to encourage fishermen to use sail. He cites as an example the 25 or 30 skipjacks dredging oysters in Maryland's Chesapeake Bay waters.

"The only ones allowed to dredge there are the guys that sail," Blake says.

"So far, the people who take the idea seriously are the guys sixty or seventy years old— the ones who can still remember working under sail. They know it can be done."

For Paul Lockwood, the interest is not so much in boats, but sails. Lockwood, who has 20 years of experience in yachting and charter sailboats, makes sails for pleasure craft in Beaufort. But he sees, in the next few years, a new market for his product developing among commercial fishermen.

"I think it's going to take a more drastic increase in fuel prices," Lockwood says, "then you're going to see some fishermen going to the trouble and expense of sail. But almost all of them could benefit from it to some extent."

Lockwood is hoping to supply the sails for these fishermen. To convince them, he's planning to outfit a "demonstrator."

"Right now, I'm trying to buy a fifty-foot sailing yacht. It is a very heavy-duty yacht, and I plan to rig it out for commercial fishing. We'd actually get a crew on it, maybe sometimes this summer, and let people see first-hand that it will work."

Lockwood points to a similar project in the Tampa, Fla., area. The CSY Yacht Corporation of Tampa has been especially successful running a leasing service for the owners of the yachts it builds and sells.

According to John Van Ost, sales administrator for CSY, the company's leap into sailing workboats was inspired by a local fisherman.

"One of the fishermen down here came by one day a few years ago and bought one of our rejected hulls, Van Ost says. "He rigged it out for commercial fishing, and after he'd been using it for a while, word got around that his fuel bill had gone from six hundred dollars a trip to about a hundred and fifty dollars a trip. The same things that make the hull good for the leasing business— durability, strength, and stability in rough weather— make it adaptable for commercial fishing."

So far, CSY has built six sailing workboats designed especially for commercial fishing. All of them have been sold, at about $150,000 each. The model is a 44-footer with a full keel, a sloop rig, roll furling, an insulated hold, an on-board freezer, an array of electronics and a 85-hp Perkins diesel.

Van Ost says the boats cruise at 8½ knots under sail with average winds. The deck of the yacht has been modified to create more work space and to accommodate the gear.

"We're using the sail to assist the diesel and to extend the efficiency of the boat, to make fishermen more competitive," Van Ost says. "We're able to use sail here about fifty percent of the time. It will work especially for the snapper-grouper fishery, for long-lining, gill-netting, and for a number of other things that don't require dragging a heavy net."

CSY is not waiting for a market to develop among fishermen before it promotes its boats. It is creating at least part of its market in its own "fishing school," an academy of commercial fishing opened in January. In its six-month courses, the school teaches would-be fishermen— not only the basics of how to fish, but also the principles of sailing. The ten students already enrolled are getting first-hand experience aboard CSY sailing workboats.

The company is even establishing Gulf Coast "fishing centers" where local fish houses will work sailing vessels into their operations, with assistance from the company.

Don Sweat, Florida Sea Grant's marine advisory agent in the Tampa area, has been helping the company plan these centers, and advising them on the workings of the commercial fishing industry.

"The boat they're building is a real Cadillac," Sweat says. "I think there's going to be a lot of interest in this whole project, whether the sails prove themselves efficient or not. The design of the hull just means you're going to save fuel."

Sailboats built To work (play!)

There are a couple of rather startling sailboats stirring in the waters around Beaufort. No frills. No snazzy paint job. Just white, basic, and business-like.

Mark Fonseca and Susan Schmidt-Fonseca, and Jud and Martha Kenworthy, have revived the art of fishing under sail with one of the state's most venerable old designs: the Core Sound workboat.

"We both like to sail, and we both like to fish," says Mark, "and we can't afford two boats. It seemed like a logical choice."

"We weren't sure at first that it was possible," Susan says of the job of combining those functions. "Then we found out about Bryan (Bryan Blake, the boat-builder), and he was already working on the idea."

With Blake's help and supervision, the Schmidt-Fonsecas and the Kenworthys put hours into building the first of the boats, the 20-ft. *Tortuga*, which the two couples shared until Mark and Susan decided to build one for themselves— a little larger, since they wanted more deck space for fishing and some cabin space for weekend sailing trips. Their 30-footer, the *Sakonnet*, was launched

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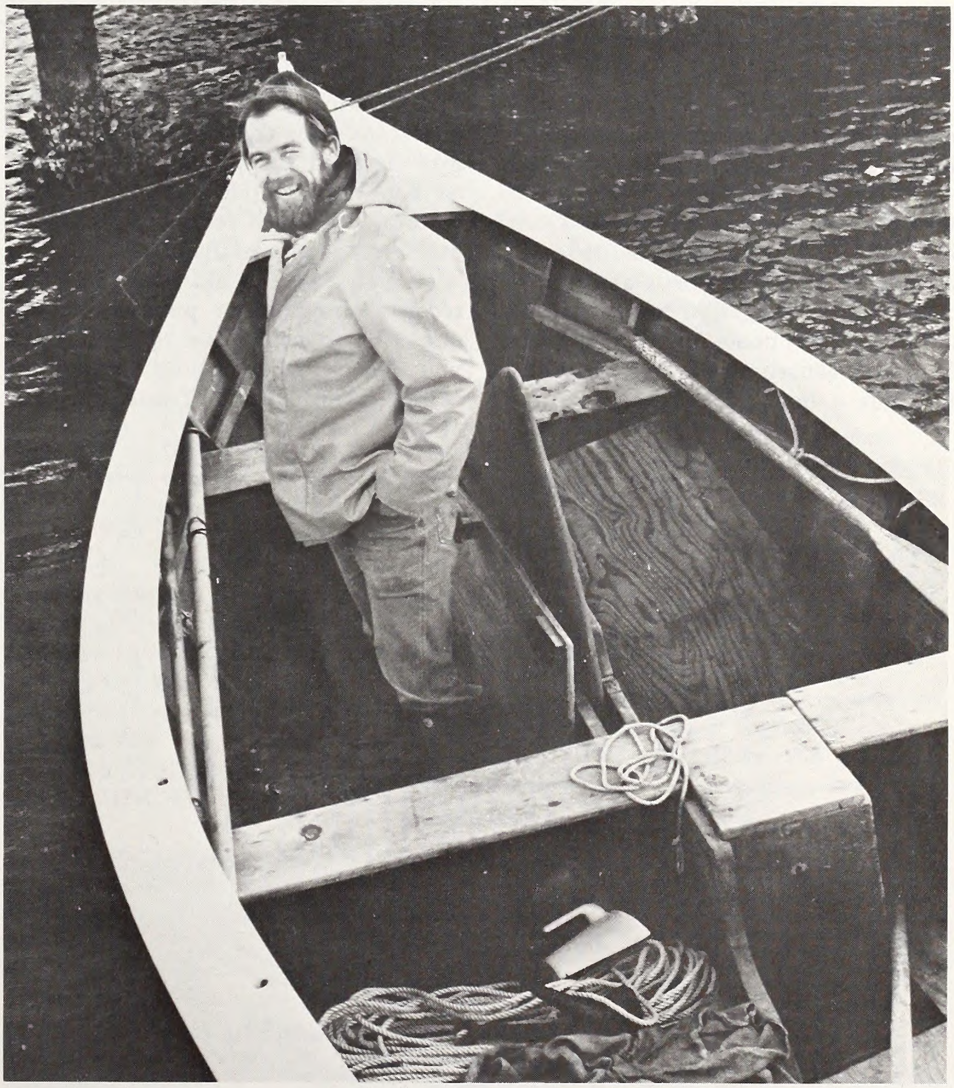
Photo by Neil Caudle



Jud Kenworthy in the Tortuga

last year.

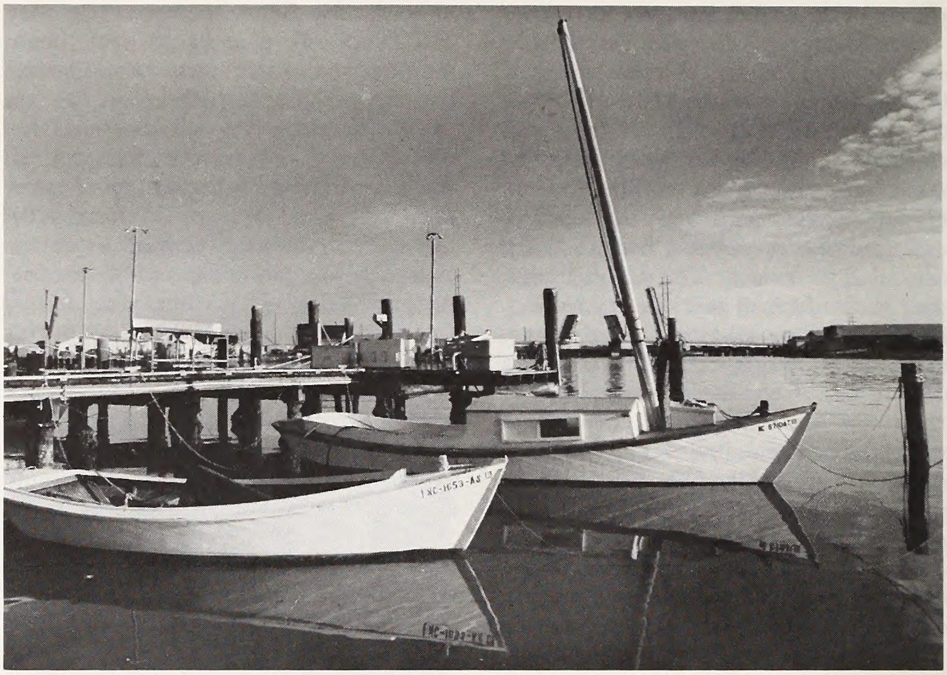
Both boats are designed to use small auxiliary engines during fishing operations.

"There are times when I'd like a little more power," Kenworthy says. "You couldn't make a living, I don't think, using these boats for commercial fishing— not unless the cost of fuel just goes out of sight."

"You can use them mostly with passive fishing methods," Mark adds, "gill netting, oystering, channel-netting, that kid of thing."

Susan sees the boat as insurance against hard times, since it would be able to provide them with some food and income, without the expense of a lot of fuel. Building the boat, she says, was an exercise in compromise.

"But it works out. We have a pact. I won't yacht-up his fishing boat, and he'll keep the fish guts out of the cabin."



The Tortuga *and the* Sakonnet, *minus sails and crew*

Almost lost— the art of fishing under sail

According to Mike Alford, the state's fishermen and boatbuilders can learn a lot about wind-powered workboats right in their own backyards. There are hundreds of fine old sailing workboats discarded and moldering in creeks, sheds and yards.

Alford has begun a study of the state's historic boats for the Hampton Mariners Museum in Beaufort. When he finds a boat with historic importance, he measures it, photographs it, and transforms the lines and contours into detailed blueprints. Eventually, he hopes to compile a book of these studies, a work of reference for boatbuilders and historians alike.

(If you have an old boat, or have records, drawings or photographs of one, Alford would like to hear from you. Write: Mike Alford, Hampton Mariners' Museum, Turner Street, Beaufort, N.C. 28516.)

Alford believes that without the introduction of cheap gasoline in this century, the old classics of the state's fleet would have continued to evolve.

"I believe that what we've seen is a sudden interruption in the natural development of the boat," he says. "We almost, but not quite, lost the art of fishing under sail. We need to go back to the extremely efficient boats of a couple of generations ago, and pick up where we left off."

Alford points to three mainstays in the old North Carolina sailing fleet of workboats:

—The sharpie, used mainly for oyster fishing along the shallows of the central coast, beginning in the late 1800s.

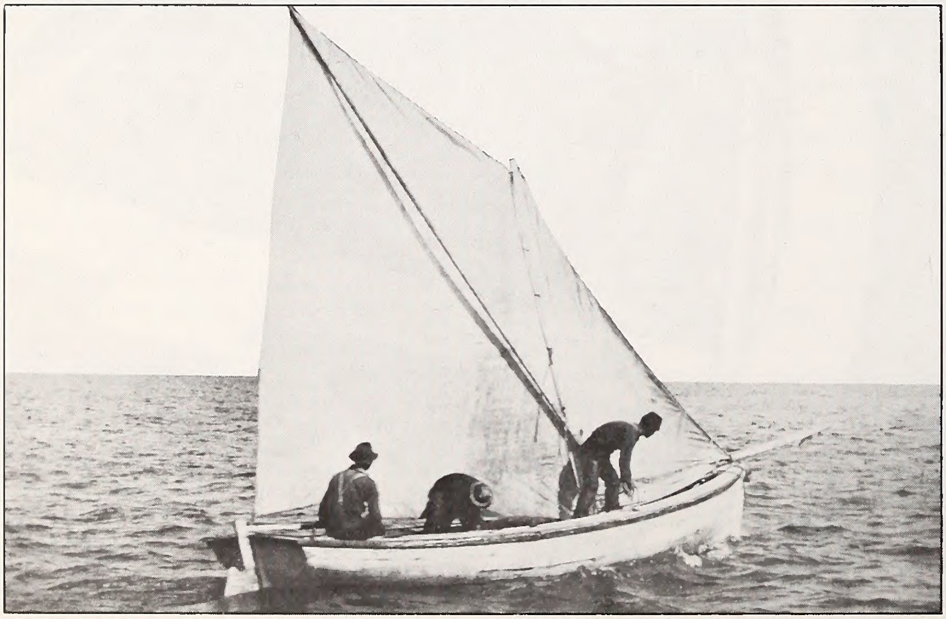
—The spritsail skiff, a late-19th century craft used up and down the coast.

—The Albemarle shad boat, which may have been indigenous to North Carolina.

Each of these types evolved to suit the locations, fisheries and economic conditions of the times, Alford says.

"Some of these boats are crumbling away in the marsh somewhere," Alford says. "But if we study them, we can learn— not only about where we've been, but also something about where we might go from here."

Courtesy of Hampton Mariners Museum



An Albemarle shad boat at work with spritsail rigging

THE BACK PAGE

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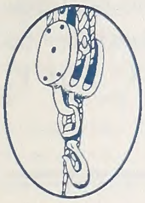

Winter air is dry and cold. And for fishermen, the combination of wet hands and dry air can mean chapped skin. Cracked and broken skin is an entry point for bacteria and fungus that can cause sores and rashes.

For years, fishermen have dipped their hands and work gloves in bleach to kill off the bacteria. But the bleach only dries out the skin more. Jim Patterson, a dermatologist at the University of North Carolina at Chapel Hill, suggests fishermen use a mild solution of peroxide or an antiseptic solution called provodone iodine to ward off bacteria. Patterson says if fishermen soak their gloves in bleach they should rinse the gloves in fresh water before wearing them. He suggests fishermen use lotion frequently during the winter and consult with a doctor if sores or rashes appear.

Bill Rickards, UNC Sea Grant's associate director, is resigning June 1 to become director of the Virginia Marine Science Consortium. In his post, on the Charlottesville campus of the University of Virginia, Rickards will coordinate all of Virginia's Sea Grant programs.

Rickards joined UNC Sea Grant as assistant coordinator in 1971. In addition to his administrative responsibilities, he has conducted aquaculture research and has directed the NCSU Eel Culture Project.

Peter Fricke, an East Carolina University (ECU) anthropologist who has worked on several Sea Grant research projects, has temporarily joined the National Marine Fisheries Service's Office of Resource Conservation and Management in Washington, D. C.

In his new post, Fricke will advise federal officials on social-science issues related to the management of fisheries. He will also work part-time for Sea Grant's national office.

Fricke is principal investigator for a new Sea Grant project this year on recreational sound fishing in North Carolina. Marcus Hepburn, an anthropologist with the Institute for Coastal and Marine Resources at ECU and a former Sea Grant research assistant, will take over some of the work on the project. Hepburn will also help with Fricke's share of a Sea Grant study of hard-clam harvesting methods.

Sportfishing Gear Maintenance, an illustrated bulletin, provides tips on how to clean and pack away your rod and reel at the end of the fishing season. From restoring the reel handle to rewinding the line guides, the bulletin tells fishermen how to ready their equipment for the next season. Part of the "Blueprint" series, this bulletin can be obtained free by writing Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650. Ask for UNC-SG-BP-81-1.

A revised edition of *Wreck Diving in North Carolina*, by Dennis Regan and Virginia Worthington, is off the presses. The booklet describes 43 of the state's underwater wrecks, relating their locations and depths. It also provides the locations of inland and coastal dive shops along with a list of nearby decompression facilities. If you would like to receive this free publication, write Sea Grant and ask for UNC-SG-78-13.

Sea Grant has also recently published a *Diver's Emergency Information Card*. The card could save your life by providing vital information if you are involved in a diving accident. The card also lists the names, locations and telephone numbers of the nearest hyperbaric chambers. The card is free for the asking from Sea Grant.

Estuarine Shoreline Erosion in North Carolina is a series of five colorful posters depicting erosion in four of the state's major estuaries: Core/Bogue Sounds, Albemarle Sound, Pamlico River and Neuse River. Written by Stan Riggs, Mike O'Connor and Vince Bellis, each poster includes a map with a description of shoreline types and erosion rates. The fifth poster, "Cause and Effect," explains the reasons for estuarine erosion. The posters are free from Sea Grant, but please specify which poster(s) you would like.

When business is good, there are about 500 women shucking scallops in North Carolina. Proposed changes in New England shellfish regulations would jeopardize the jobs of these women, half of whom are black.

This year, two Sea Grant fellowships have been awarded to two black students who will study the problem. Tony Arnette and Audrey Robinson, two sophomores studying sociology at ECU, will code, analyze and report data on the economic and social impacts of the proposed regulations, focusing on the role of black families in the development of the fishery. John Maiolo, an ECU sociologist and Sea Grant researcher, will direct the project.

Continued on next page

Sea turtles are having a hard time these days. Their numbers are dwindling and many are on the endangered species list. The disappearance of nesting grounds on the beaches is one major cause of the turtle's decline. But many sea turtles die every year when they get caught in fishermen's nets and drown.

The National Marine Fisheries Service (NMFS) is sponsoring a workshop in Manteo in mid-March for the North Carolina and Virginia Sea Grant marine advisory services agents to explain a new sea turtle excluder device. The device is designed to keep turtles out of the fishermen's nets. After the workshop, Sea Grant agents will be able to pass along the new information to fishermen in their areas.

The fisheries personnel will also explain sea turtle regulations being considered by NMFS for the coasts of South Carolina, Georgia and Florida, fishing grounds for many North Carolina fishermen.

To catch the latest in workboats and nets for small-boat fishing, attend the Workboat Expo being held in Wilmington, April 4th and 5th. Sponsored by UNC Sea Grant, the expo will gather small-boat designers, manufacturers, and dealers, along with net makers to exhibit their wares for small-boat fishermen. A series of free mini-seminars also will be held during the expo on gear maintenance, tax management, fishing regulations and business management.

The expo was organized by Sea Grant marine advisory agents Jim Bahen in Wilmington and Bob Hines in Bogue Banks and Sea Grant specialist Leon Abbas in Raleigh. It will be held at the National Guard Armory, 2221 Carolina Beach Road in Wilmington. The expo will be open to the public Saturday, April 4th from 10 a.m. to 5 p.m. and Sunday, April 5th from 11 a.m. to 5 p.m. Admission for the expo is free.

The University of Georgia Extension Service is sponsoring a regional workshop for shrimp boat operators who are interested in converting to multi-purpose fishing. The workshop will be held March 31 and April 1 at the Ramada Inn in Savannah, Georgia.

Topics to be covered by experienced fishermen include offshore trawling for fin fishes; surface and bottom longlining; hook and line fishing and deepwater shrimping and scalloping. Boat construction and financing for diversification will also be discussed.

Funding has been provided by the Coastal Plains Regional Commission, Georgia Sea Grant and the University of Georgia. For pre-registration or further information, call Dave Harrington or Jack Rivers at (912) 264-7268.

Attention

We are purging the newsletter mailing list, and a postage-paid subscription card for you is in the mail now. We are required by law to periodically purge the list of *Coastwatch* subscribers. *Coastwatch* is free, but you must renew your request for it in order to remain on the mailing list.

If you would like to continue receiving *Coastwatch*, just fill out the card and drop it in the mail. If you do not receive a notice, send your name and address as soon as possible to *Coastwatch*, Box 5001, Raleigh, N. C. 27650.

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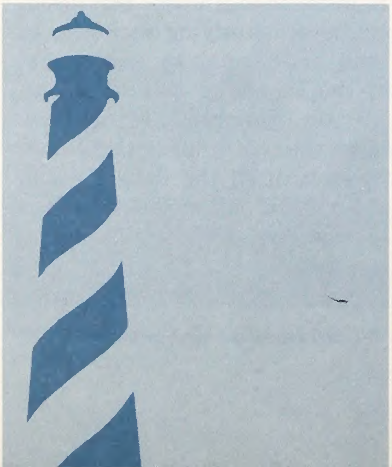

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COASTWATCH

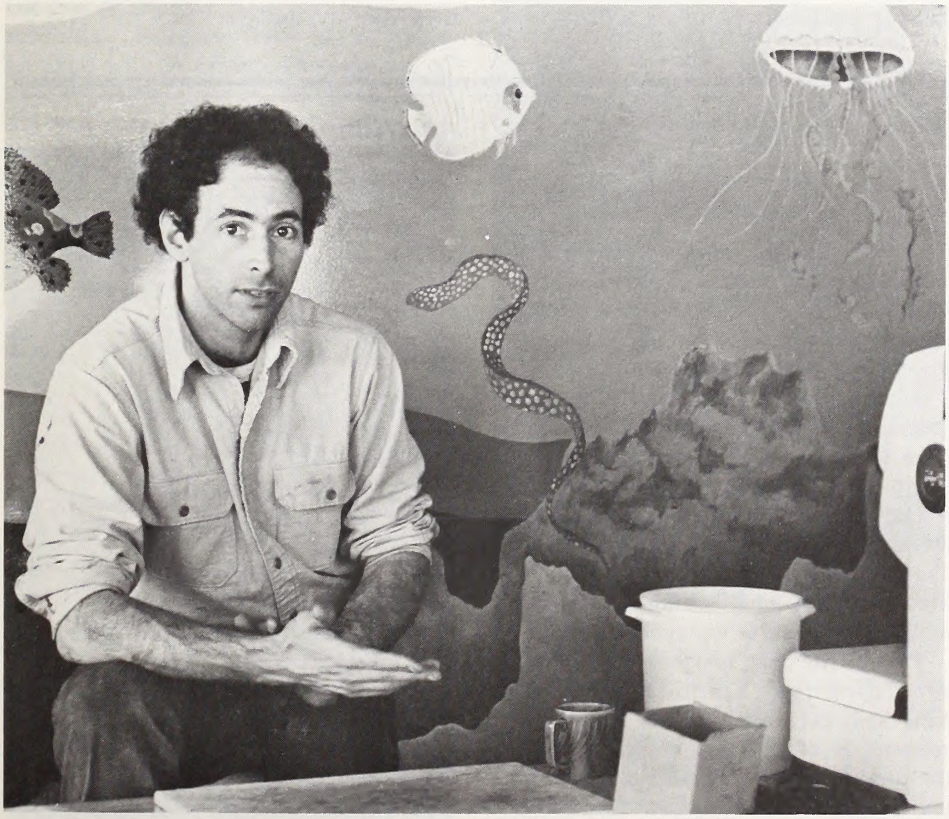
Why smoked fish in North Carolina?

Centuries ago, the coastal Indians began smoking fish over glowing embers as a means of preservation. By using this method, the catch from a good fall fishing trip could be enjoyed throughout the lean winter months. However, as time passed and refrigerators came into being, preservation was no longer the primary reason people were still smoking fish. The rich, distinctive flavor produced by smoking kept the fires burning and the product in demand.

In North Carolina, the smoking tradition is still maintained in many backyard home smokers and in two commercial businesses. The state's waters are rich in resources, and smoking provides a good market for some species, such as bluefish and mullet, which do not keep well in frozen storage.

And, for the latest in research and general information, the Sea Grant staff at the NCSU Seafood Lab is ready to answer questions from smoking techniques to which seafoods smoke best and why. With resources and research, potential for seafood smoking is great in North Carolina.

Photo by Cassie Griffin



Andrew Michaels, owner of the Chapel Hill Smoked Fish Company

A delicacy in demand

Three years ago, a young man in North Carolina decided to turn a hobby into a business. Now, on quiet Friday afternoons in his shop outside Chapel Hill, customers stream in to buy his product. By Saturday noon, it's standing room only. And, by Monday, a 500-pound order has been packed and shipped to a supermarket outside Washington, D.C.

The product that many faithful customers and wholesalers buy week after week is smoked bluefish from North Carolina waters. And, business is truly booming for Andrew Michaels, owner of the Chapel Hill Smoked Fish Company. He attributes the success of his retail business to the large cosmopolitan population in the Triangle area, "a consumer sophistication," Michaels says.

Continued on next page

A native of New York City, Michaels moved to this state to attend the University of North Carolina at Chapel Hill. While fishing commercially off Harkers Island, he started smoking fish as a hobby.

"I grew up with smoked fish," Michaels says, "and I have a fondness for all the different kinds. I built my first smoker out of an old refrigerator, and it suited my needs just fine. Later, when I had a restaurant in Chapel Hill, I put smoked fish on the menu, and it was real popular."

At the time Michaels opened his business, it was the only commercial smokery in the state. (Last fall, another smoked fish business opened in Swansboro.) "I have developed a market for smoked bluefish that we fillet and use our own special process here," he explains. "Regularly, we smoke fresh rainbow trout from the mountains of North Carolina and also white salmon from British Columbia. And, when we can get it, sturgeon."

Although blues from the Pamlico Sound account for 80 percent of the total sales, the Chapel Hill Smoked Fish Company does a good business with its other smoked products and specialty seafoods. In the refrigerated case, frozen conch and squid are displayed alongside smoked eel and turkey. Other products include Florida red snapper, king mackerel, king salmon and swordfish, in addition to local seafoods.

Europeans and northerners who grew up with smoked fish as a staple in their diets make up his regular clientele, although southerners are increasingly among his customers. "All of my during-the-week customers," he says, "are steady, once-a-week customers. As readily as they go shopping for butter, milk and eggs, they come and get smoked fish."

CAROLINA
WATERS
SMOKED BLUEFISH

The Chapel Hill Smoked Fish Company
Fish Smoking Done Here!

Chapel Hill
NC
27514

"It did real well right away," Michaels says, "and paid the bills from the very day it opened." Seeking markets elsewhere, he says, "I tried my back door," and now sells regularly to a dozen local restaurants.

"I'm just starting to branch out now," he explains, "and I'm doing a really nice wholesale business in Washington, D.C., Greensboro, Charleston, South Carolina, and I just started with Wilmington a few weeks ago." Although wholesale sales account for only 20 percent of his business, Michaels expects that to approach 50 percent in the near future. "Right now," he says, "I'm operating at about 20 percent capacity."

But, what do you say to the consumer who thinks $5 a pound is too much to pay for smoked fish? Michaels has an answer.

"Number one," he explains, "you're talking about a fillet of a product, so you don't have any waste. Number two, you're also talking about a product that's already cooked and ready to be eaten, so you don't have any energy and time involved in cooking it. You also don't have any shrinkage. Furthermore, the smoking enriches the product in such a way that you consume very small quantities. It's not ordinary; this is a gourmet, premium product."

"So, when you put all of these factors together," he says, "it's not that expensive. I haven't raised my price in three years, since I've been in business. All they gotta do is taste my product, they like it, and they buy it."

Adding technology to an art

For centuries North Carolinians have been smoking fish as a means of preservation. The techniques used by the coastal Indians years ago are still in practice today. And, according to Sam Thomas of the North Carolina State University Seafood Laboratory in Morehead City, "Smoking is still basically an art here in the United States that's been acquired through experience." But, that's changing now.

Jointly operated by Sea Grant and the North Carolina Agricultural Extension Service, the Seafood Lab is involved in research to improve the quality and to promote the use of North Carolina seafood products. Research efforts are then extended to seafood processors and consumers. The Seafood Lab has just recently started looking into smoking seafood. Thomas says smoking is especially good for some species that do not keep well in frozen storage, such as mullet and bluefish. "These species have never brought a good price to fishermen," he says, "and they're very abundant."

A year and a half ago, the lab acquired a smoke box which has since been in operation 16 times. "The first five or six times, we were just getting a feel for the box," Thomas says, "then we started doing some different species like eel, bluefish, shark, trout, ray, octopus, mullet and scallops. We had really good results on everything."

Two of the best species for smoking, according to Thomas, are the American eel and bluefish. "High fat content is of primary importance to the final product," says Thomas, "and the oil in the eel carries the flavor beautifully. Mackerel and mullet are also good."

Photo by Cassie Griffin

Susan Lovelace in the lab

Recently, the Seafood Lab smoked 40 pounds of fresh bluefish fillets, using both the brining and dry salt techniques. A portion of the fish was brined in a mixture of six percent salt for 16 hours, rinsed, drained, and placed in the smoke box skin side down. The remaining fish were skinned, divided in half and rolled in and rubbed lightly with a dry salt cure and a dry salt and sugar cure. The dry salt cure consisted of one pound of salt mixed with one-half ounce of black pepper, and the salt and sugar cure had one pound of sugar added to this mixture. These fish were allowed to sit in the cures for 30 minutes, then rinsed, drained, and placed in the smoke box. Smoke time was approximately six and a half hours, and hickory sawdust was used for the smoke. When the larger pieces of fish reached an internal temperature of 160°F, everything was taken out of the box to cool.

"The Food and Drug Administration," Thomas says, "recommends that the final salt content in a smoked product be two and a half to three and a half percent. We have found the latter to be a little too much salt. So, we are studying different brining procedures."

Susan Lovelace, a technician at the Seafood Lab, is analyzing samples of the last products for several studies in smoking. Results from a chlorine analysis will determine the amount of salt in the bluefish which was brined, dry salt cured, and dry salt and sugar cured. Lovelace says, "We will be studying different salt concentrations to get a more palatable fish."

"We are trying to get a good relationship between smoke time and temperature, too," Lovelace explains. "We will be working with several different species, such as bluefish, mackerel, mullet, and white and blue marlin, and their seasonal variations. There are fat differences at various seasons, and we will be working to compensate for that and still come up with a quality, uniform product."

In addition to these studies, Lovelace and lab personnel will be running tests on smoked fish for rancidity, shelf-life storage and nutrition. Previous research from other Sea Grant programs and agencies hasn't included specific information on species native to North Carolina, such as the bluefish. At present, there are only two commercial operations smoking bluefish outside of the Seafood Lab research—Reef Lite Fish Company in Swansboro and the Chapel Hill Smoked Fish Company.

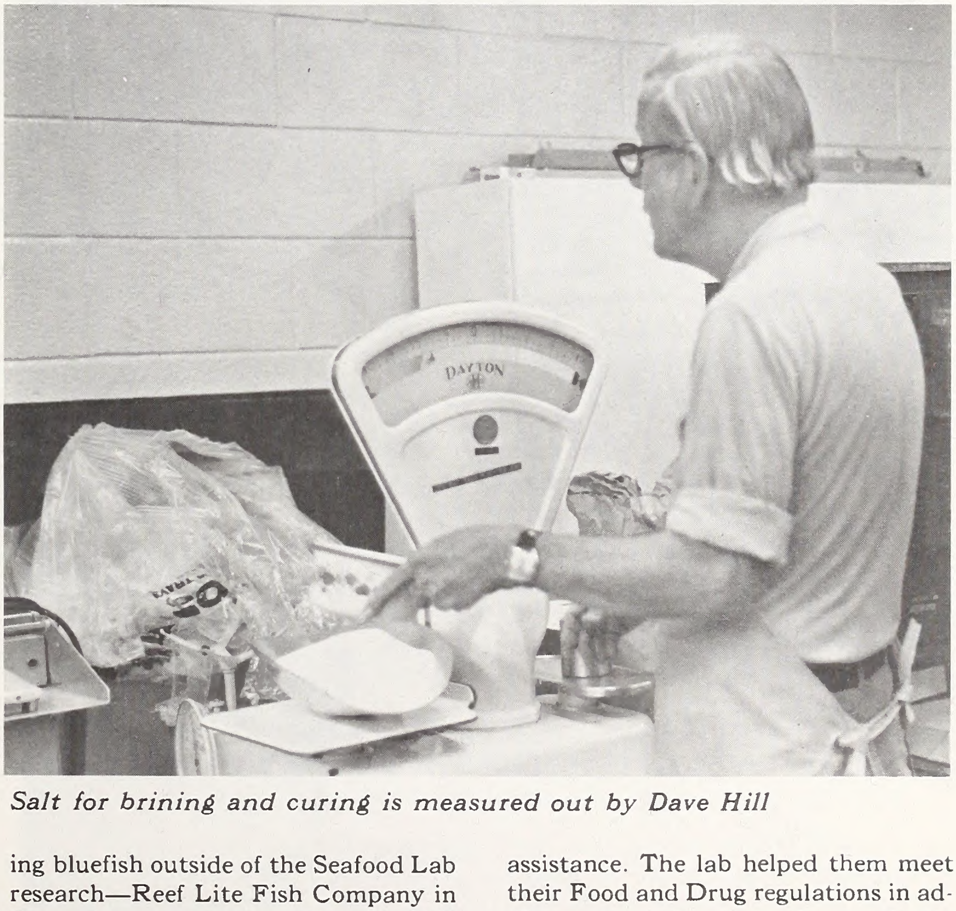
When Dick Barlow and Bruce Paulson of Reef Lite decided to open their smokery, they came to the lab for assistance. The lab helped them meet their Food and Drug regulations in addition to informing them of the necessary permits needed to start their business. Seafood agent Dave Hill,

Continued on next page

Photo by Cassie Griffin

Sam Thomas prepares a bluefish for brining

Photo by Cassie Griffin



Salt for brining and curing is measured out by Dave Hill who works with seafood processors in designing their plants, also helped them turn a small concrete building into an approved smoked fish processing plant.

"Basically, I worked with them on the building they had," Hill explains, "and developed some plans which included expansion. In any of these processing plants, you try to set up a good work flow so you're not backtracking. At Reef Lite, there is a cool room to keep the raw product chilled, a filleting room where the fish are headed, gutted and brined, the smoke box, and a second cool room where the finished product is air-cooled and packaged. They also have a small retail counter and display case," he says.

Although there are only two commercial businesses in the field now, smoking in North Carolina has the potential to offer some competition to the European and other United States markets, according to Thomas. "Many of the smoke houses in the foreign countries are using very sophisticated, computerized machinery, probably more like we see in the ham smoking operations here. And, we have smoking operations scattered in this country—herring in Canada and the North Atlantic states, smoked salmon in California, mullet and other species in Florida, and a lot of smoking in Chicago, the Great Lakes area and New York."

Thomas admits that it is going to be a while before the average consumer in North Carolina is ready to spend $5 a pound for smoked fish. And, he thinks that a large population with a diversified, cosmopolitan background is essential to successfully marketing specialty food items. "But, I think there is quite a bit of backyard smoking going on," he says, "because we get a substantial number of requests for information. A lot of people are interested in it, and they like the flavor smoking gives to food. Everybody loves to do something with food. Besides, it tastes good."

Photo by Cassie Griffin

Sam Thomas takes out a tray of smoked bluefish

Photo by Cassie Griffin

The finished product

Marketing a premium product

About a year ago, Bob Hines, Sea Grant marine advisory services agent at Bogue Banks, got a call about some eels. He agreed to meet the caller at the NCSU Eel Culture Project in Aurora, but little did he realize the future importance of that call. The caller was Alex Catenis of the Alpha Export Import Company, a firm which specifically exports fish products to Europe. And, Catenis had picked the right man to contact that day.

As part of his daily work, Hines deals with commercial fishermen and seafood processors in North Carolina's central coastal area. A major responsibility is finding markets for the fishermen's catch. And, the Sea Grant-Alpha meeting produced another market for eels.

Catenis says, "Basically, my function is to keep our manufacturing plants in Germany and surrounding areas running full time with eels. We have highly sophisticated computerized smokers, and we are anticipating buying a minimum of 40,000 pounds of North Carolina eel in 1981 for smoking."

According to Catenis, Europeans eat fish products at 70 percent of their meals. "It's so readily available, very nutritious and low in cost. In Europe, fish markets with smoked, fresh and frozen fish products are what the butcher shops were to the United States twenty-five years ago."

Photo by Neil Caudle

Bob Hines

In addition to eels, Catenis is also hoping to experiment with other North Carolina species, such as bluefish and mullet. "I hope the bluefish will go," he says, "and if they do, we will open up a good market for fishermen on the coast. I have high hopes for the bluefish." Samples of bluefish and mullet are now being sent to the German plants for tests.

To meet his company's immediate needs for eels, Catenis has worked up a long-range plan that will eventually establish new business in North Carolina. Presently, he wants to obtain more North Carolina eels and reach more eel fishermen that will fish for his company and meet his specifications. In Canada, he has an organization of eel fishermen working for Alpha, and he would like to duplicate that here. Catenis and Bob Hines are also working on constructing an eel grader similar to one used now in Canada. Eventually, with a good eel fishery established, an eel processing plant and a smoking business could be constructed on the coast.

Smoking your catch

Photo by Cassie Griffin

For home smoking, a short stem metal meat thermometer is necessary for measuring flesh temperature

For excellent fish and seafood to smoke at home, North Carolinians need go no further than the nearest stream or ocean waters for an abundancy in resources. Joyce Taylor of the Seafood Lab recommends fish high in fat content, such as bluefish, mullet, trout, mackerel, herring, eel, catfish and amberjack. Fresh clams, oysters, scallops and shrimp can also be smoked successfully.

For the home smoker, a simple smoke oven can either be purchased ready-made or constructed from an old refrigerator, stove, barrel or even with a foil tent over an hibachi. Non-resinous hardwoods, such as hickory, oak, apple, maple or birch, impart the best flavors.

The procedure described below for home smoking is recommended by the University of Wisconsin Sea Grant Program. For more information on smoking techniques and home smokers, write the NCSU Seafood Laboratory, P.O. Drawer 1137, Morehead City, N.C. 28557 or call (919) 726-7341.

1. Use freshly caught dressed fish, whole or filleted. Larger whole fish can be split lengthwise to, but not through, the back skin so they will lie flat. Very large fish can be steaked. Wash the fish thoroughly.

Continued on next page

2. Fish for smoking must be brined. Use either of the following methods. One gallon of brine is enough for 4 pounds of fish.

   A. As the fish are dressed, place them in a glass or heavy plastic container in a brine consisting of 1½ cups of salt to 1 gallon cold water. Keep the fish in the brine for at least 12 hours at refrigerator temperatures (40°F).

   B. For a short brine method, use a brine of 4 cups salt to 1 gallon cold water. Soak for 15 minutes.

3. Remove the fish from brine and drain. Rinse to remove salting mixture. Place fish skin side down on a wire mesh screen or suspend on hooks or wooden dowels. A method which holds the fish flat provides for more uniform smoking.

4. A short stem metal meat thermometer should be inserted centrally in the thickest portion of the flesh of the largest fish to measure flesh temperature. It may be necessary to tie the thermometer so it will register correctly.

5. An old iron skillet on an electric hot plate can be used as a heat source for the smoker. Place sawdust or wood chips in the skillet and allow them to smolder. An alternate heat source is charcoal briquets which have been burned to a light gray color. Sprinkle wet wood chips or wet sawdust on the briquets to produce smoke.

6. Oak, hickory, maple, alder, beech, apple, white birch or ash wood chips or sawdust produce a good smoke. Do not use wood containing pitch, such as pine. Wood can be chipped or cut in pieces about 8 inches long and 1 inch in diameter. Sawdust burns slowly and produces good smoke. Too heavy smoke overemphasizes the smoke flavor.

7. Kindle fire and get a good bed of coals going before placing barrel over fire. Have a smoldering fire with no flames. Stoke the fire every half-hour or as needed.

8. Place the fish in the smoker when the air temperature is about 100°F. A regular meat thermometer can be hung on a rack in the center of the smoker or inserted through a hole in the smoker cover to guide you on temperature. During smoking, the internal temperature in the smoker should rise to 225°F. At this air temperature, the fish flesh will be approximately 180°F. Holding the fish at this temperature for 30 minutes is essential to cook the fish and inhibit bacterial action. Total smoking time will be about 4 hours.

9. As soon as the smoking is completed, wrap the fish in waxed paper and place in the refrigerator. The fish must be stored at temperatures not over 45°F and used within a month.

Recipes

Dillicious Dip*

1 cup smoked fish, flaked
8 oz. cream cheese, softened
¼ cup half and half cream
1 tablespoon finely chopped onion
2 teaspoons lemon juice
½ teaspoon dried dill weed
½ teaspoon Worcestershire sauce
¼ teaspoon garlic salt
¼ teaspoon salt
⅛ teaspoon pepper

Combine fish, cream cheese, onion, lemon juice, dill weed, Worcestershire sauce, garlic salt, salt and pepper. Mix well. Chill. Serve with favorite snack crackers. Makes about 2 cups.

Smoked Fish Salad*

1 lb. smoked fish, flaked
2 cups diced cooked potatoes
1 cup celery, thinly sliced
½ cup sliced peeled cucumber
½ cup ripe sliced olives
¼ cup grated carrot
¼ cup minced onion
2 tablespoons chopped parsley
½ cup mayonnaise
1 tablespoon prepared mustard
1 teaspoon lemon or lime juice
1 teaspoon vinegar
Salt to taste
¼ teaspoon celery seeds
Dash of black pepper

Combine vegetables and fish in large bowl. Mix mayonnaise, mustard, lemon or lime juice, vinegar and seasonings, blending thoroughly. Add to fish and potato mixture and toss lightly. Chill well. Serve on a bed of greens. Serves 6.

Smoked Bluefish and Gruyere Quiche**

2 8" baked pie crusts (frozen)
1 13 oz. can evaporated milk
8 oz. gruyere (or Swiss) cheese
8 oz. smoked bluefish pieces
4 eggs
½ teaspoon salt
¼ teaspoon paprika
dash cayenne
3 tablespoons grated onion

To heated milk, add cheese and spices. Remove from heat slowly and add fish and gently fold in beaten eggs. Fill crusts and bake at 325° for about 45 minutes. Serve hot or cold. Serves 12.

Smoked Bluefish Omelet**

2 oz. smoked bluefish, flaked
2 eggs
1½ oz. cream cheese
scallions
butter

Over medium heat melt butter. Pour in eggs and wait 30 seconds. Then add cream cheese cut thinly, bluefish and scallions. Cook over very low flame. When eggs are almost done, fold omelet in half. Then flip and cook 30 seconds more.

* NCSU Seafood Laboratory
** Chapel Hill Smoked Fish Company

THE BACK PAGE

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If you own property at the beach, give a thought to your dunes. Are they well-covered with a healthy stand of sea oats or beach grass? According to Spencer Rogers, Sea Grant's coastal engineering specialist, grasses hold dunes in place and help them resist erosion.

If your dunes are balding and lack vegetation, this is the time of year to try some transplants. Rogers says that successful transplanting begins with the right fertilizer. Choose a granular variety containing nitrogen—"8-8-8" or "10-10-10" will do—and broadcast it onto the bare dunes or pathways. You can find American beach grass plants in nurseries along the coast, or you can select young plants from a good stand on your own property. Remember, it's illegal to take dune grasses from public land.

Dig the grasses up carefully. Set single plants about 18" apart, and make sure to get them at least a foot deep, so that the roots don't dry out. As the plants establish themselves, they send out rhizomes and fill out the stand.

Rogers says it's best to keep people and traffic off the dune grasses. Only a few tramplings can kill the plants. He recommends elevated walkways for areas where people cross dunes to reach the beach.

If your lot borders a sound or estuary, and erosion is a problem, grasses might also help protect your property. Sea Grant researchers Ernie Seneca, Steve Broome and W. W. Woodhouse have found that in some areas, marsh-grass plantings can help slow shoreline erosion. If you want to know more, contact Spencer Rogers, Marine Advisory Service, N.C. Marine Resources Center/Ft. Fisher, Kure Beach, N.C. 28449.

Sea Grant Publications is an updated brochure that lists all of UNC Sea Grant's general-interest publications. The brochure provides a brief description of each publication and lists its price, if there is a change. The brochure also provides an order form that can be filled out and sent to the Sea Grant office in Raleigh for quick processing. For your free publications list, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650.

Seacoast Life: an ecological guide to natural seashore communities in North Carolina, by Judith M. Spitsbergen of the Hampton Mariners Museum in Beaufort, describes the dunes, tidal flats, marshes, plants, organisms and critters that make up coastal North Carolina. An ideal field guide for teachers and students, the illustrated book focuses on coastal ecology rather than on the identification of individual plants or animals. Funding for the book was provided by UNC Sea Grant and the North Carolina State Museum of Natural History. For a copy of the guide, make a check payable to NCDA Museum Extension Fund for $6.95 ($5.95 plus $1 for postage and handling). Send the check to Museum Publications, P.O. Box 27647, Raleigh, N.C. 27611. Or you can buy a copy by dropping by the Natural History Museum in Raleigh or the Hampton Mariners Museum in Beaufort.

Shellfish Relay: A Preliminary Review of Potential Gains from Alternative Property Rights in Southeastern North Carolina, by J.E. Easley and James D. Seabolt of the NCSU Department of Economics and Business, discusses the alternatives for and economics of relaying or transferring contaminated shellfish from polluted water to clean water. For a copy, write UNC Sea Grant and ask for UNC-SG-WP-81-1. The working paper is free to North Carolina residents, but out-of-state residents must pay $1.

Fishery Facts 9: design and materials used in construction of a 16-foot shrimp trawl, a reprint of a National Marine Fisheries publication, is now available from UNC Sea Grant. The publication is free. Ask for Fishery Facts 9.

As President Reagan sliced away at federal spending in February and March, his team outlined the shut-down of the federal Sea Grant program during fiscal year 1982. In the proposed budget he submitted to Congress, Reagan allowed only $1.8 million for Sea Grant in 1982, to be used for "an orderly phase-out of the program."

The National Sea Grant office immediately issued a "call for information" to all the state programs, including North Carolina, to document Sea Grant's contribution to the nation's coastal economies. Economic information was forwarded to Secretary of Commerce Baldridge, as well as many members of Congress who support the Sea Grant cause. As the facts poured in from across the country, the national office was able to document that the economic benefits derived from the Sea Grant programs in one year came close to matching the total federal investment in Sea Grant for all its 13 years of operation.

North Carolina Sea Grant Director B. J. Copeland will be traveling to Washington, D.C. in late March to defend Sea Grant before the House Sub-

Continued on next page

committee on Oceanography. He will be telling Congressmen how research projects, advisory services and publications like *Coastwatch* aid coastal communities. Only with sound data about Sea Grant's benefits and the backing of concerned citizens will Sea Grant survive the budget cuts.

In the Philippines, many of the best crops are under water. But the farmers like it that way. Their harvest of milkfish, catfish, talapia, shellfish, shrimp and prawns represents a major industry and a primary source of food.

The 7,100 islands of the Philippines are rich in the resources that make aquaculture work: temperate climate, plenty of clean water, and an abundance of edible species well-suited to farming.

John Foster, who works with Sea Grant's aquaculture demonstration project in Aurora, believes North Carolina can learn from the success of fish-farming in the Philippines. In February, Foster spent several weeks touring the islands, stopping at fish farms, research sites and markets. He also studied some of the nation's culture, staying with Philippine families in their homes, and saw firsthand the central role seafood plays there.

Foster believes he can apply much of what he learned on the trip to his Sea Grant work with aquaculture. He believes the Philippine techniques for raising fish in pens would work well in North Carolina's freshwater ponds and reservoirs, as well as in brackish bays and estuaries.

In exchange for their help, Foster gave his Philippine counterparts information on new technology and research, and pointed out ways they could make better use of their resources.

Foster and the five other North Carolinians who made the trip were selected to participate in an exchange program that also brought Philippine citizens to this state for study. The Rotary International Foundation, which sponsored the exchange, has asked Foster to report his observations of Philippine life to the state's Rotarians.

This summer, Sea Grant is again offering three workshops designed to help school teachers enrich their students' studies of the coast. Lundie Mauldin, Sea Grant's marine education specialist, has designed the workshops in conjunction with the three N.C. Marine Resources Centers and the N.C. Department of Public Instruction. Each workshop offers course credit through the NCSU Division of Continuing Education.

The first workshop, scheduled for July 12-25 at Bogue Banks, is open to middle-school and secondary-school science teachers, junior high prevocational teachers, vocational home economics teachers and marine occupation teachers. It will cover coastal habitats, organisms and occupational skills. Tuition is $120.

Another workshop, to be held July 29-31 at Roanoke Island, is designed for middle-school teachers from "gifted-and-talented" programs, but is open to other teachers as well. It will cover salt marshes, whales, marine survival skills and literature about the sea. Tuition is $30.

The third workshop, to be held August 12-14 at Fort Fisher, is open to life science and biology teachers. The workshop will cover collecting, maintaining and investigating marine organisms. Tuition is $20.

For an application to enroll in any of the workshops, write: Lundie Mauldin, UNC Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650. Enrollment is limited, so write soon.

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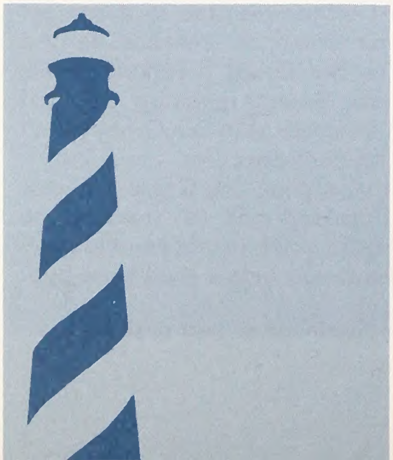

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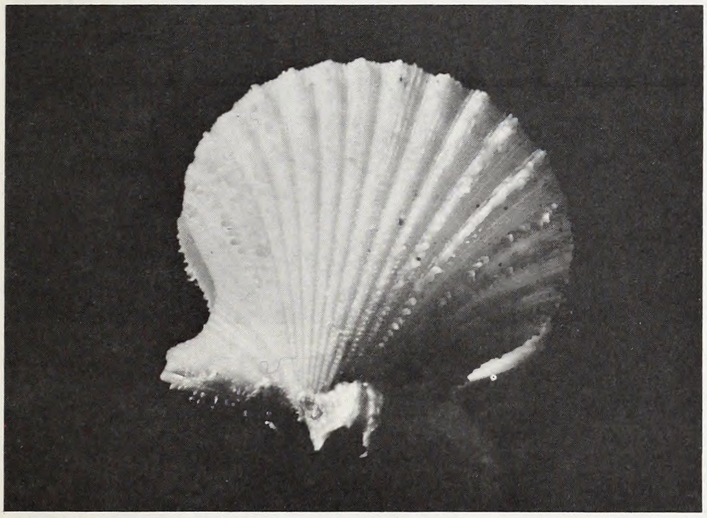
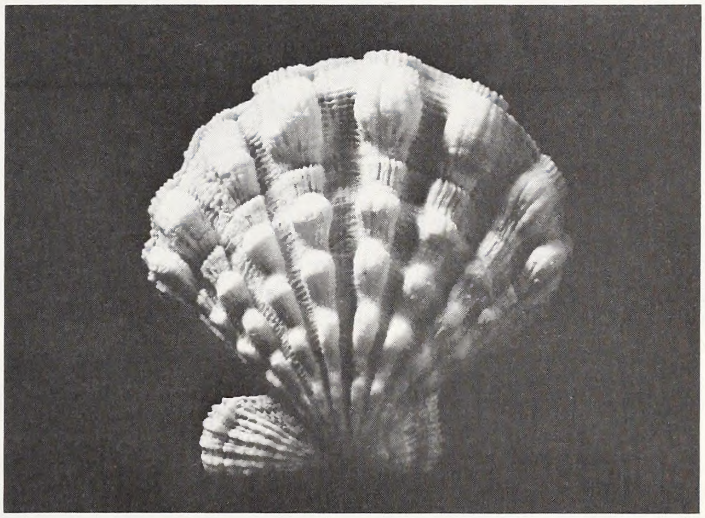
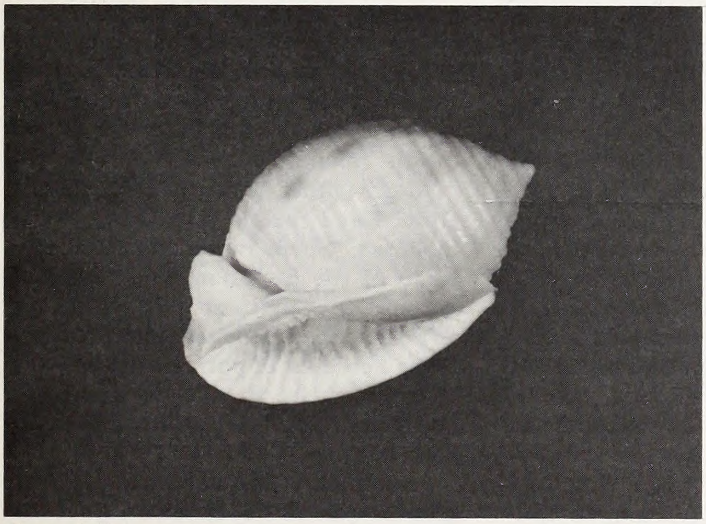
Photos by Ken Taylor



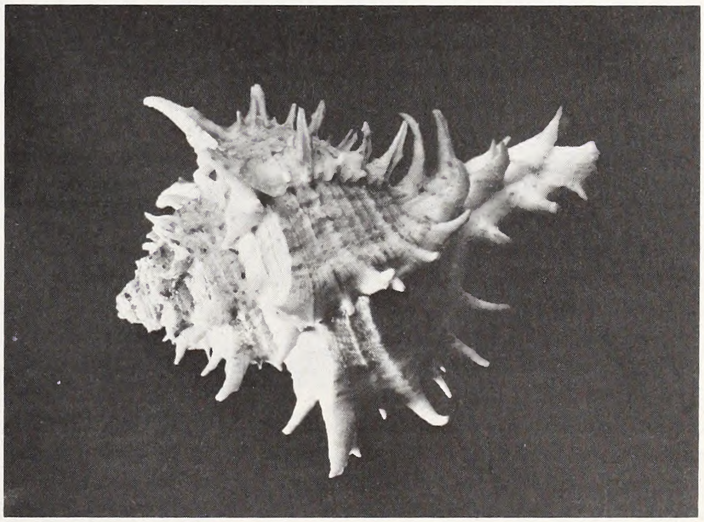
Prickly cockle



Lion's paw



Scotch bonnet



Giant Atlantic murex

To understand the life of the shore, it is not enough to pick up an empty shell and say. "This is a murex," or "That is an angel wing." True understanding demands intuitive comprehension of the whole life of the creature that once inhabited this empty shell: how it survived amid surf and storms, what were its enemies, how it found and reproduced its kind, what were its relations to the particular sea world in which it lives.

—*from The Edge of the Sea*
by Rachel Carson

Photo by Cassie Griffin

A curious animal and its house

Man has always been fascinated with the edge where land and water meet. Part of that fascination has been with seashells, the houses of soft-bodied animals called mollusks.

Mollusks, which predate man, are believed to be more than 600 million years old. Originally only marine animals, they have adapted to many different lifestyles and can be found in mud, sand, rocks, on land, and in fresh and salt waters. Worldwide, there are approximately 100,000 species, and in North Carolina, over 1,000 species are known to exist in estuarine and marine waters. Some familiar kinds are oysters, clams, scallops, and conchs.

The two largest classes of mollusks are gastropods and bivalves. Gastropods usually have a single spiral- or cone-shaped shell, and bivalves have two shells, or valves, hinged tightly with strong muscles. Bivalves are basically passive, filtering food from the water, and are the prey of gastropods. Lining the mouth of gastropods is a radular ribbon with teeth which, in whelks, acts like a scraping tool. With muscle contractions and suction, a whelk can pry open clams.

But gastropods aren't the only predators of bivalves, nor are they safe from predation themselves. Man has been using mollusks for food since the first clam was cracked open and a delicious meat discovered inside. The shells of mollusks have also provided man with inspiration for greater functional and aesthetic purposes.

The early coastal Indians in North Carolina were dependent upon many mollusks for food. According to Lundie Mauldin, marine education specialist for Sea Grant, the oyster and clam shells left in refuse piles, or middens, are now clues for permanent or temporary Indian settlements in coastal areas. "There is a tale Down East in Carteret County," she says, "about a shell causeway from Harkers Island to Cape Lookout-Shackleford Banks. They say the Algonkian Indians who lived there centuries ago had dumped so many shells in the sound that they could walk across it." Although the Indians are gone now, the local people say that remnants of the causeway remain.

Indians were also some of the earliest shell collectors. Some of the hard, durable shells left over from a feast were attached to poles and used for digging, or sharpened on one edge and used for scraping. Conchs were valued as ceremonial drinking vessels. The Indian money, called wampum, was made from circular shapes, cut out of clam shells, which were pierced and strung together. White wampum was considered less precious than the purple shells cut from the small, colored part of the shell. It is interesting that the Latin name given to the hard clam is *Mercenaria mercenaria,* which means "money."

Many other cultures throughout time have been fascinated with mollusks. Shells were found in the tomb of the Egyptian King Tut and among the artifacts of primitive African tribes. Roman senators wore togas bordered in purple from the dye of murex shells. Royalty used scallops and other shells to embellish the family coat of arms.

Artists have borrowed many of the graphic qualities of seashells, from the classic painting by Botticelli of the goddess Venus coming out of the sea on a scallop (The Birth of Venus, c. 1480) to the stylized, bright yellow trademark of Shell Oil Company. A scallop was chosen to represent the company in honor of its founder, Marcus Samuel, who collected seashells as a hobby.

Architecture has also copied the beautiful designs of many shells throughout the ages. The wentletrap, whose name is derived from the German word for spiral staircase, has been duplicated countless times. Frank Lloyd Wright, who designed the Guggenheim Museum in New York as a continuous spiral ramp, is quoted as saying, "In . . . shells we see the housing of the life of the sea. It is the housing of a lower order of life, but it is a housing with exactly what we lack—inspired form. In this collection of houses of hundreds of small beings, who themselves built these houses, we see a quality which we call invention."

Mollusks have also been used in the actual construction of buildings and roads. Shells are composed of many layers of calcium carbonate, which is limestone. Years ago, crushed oyster shells were used to make a mortar which is called tabby. When Fort Macon in Carteret County was built in 1826, tabby was used to bind the fort's 10 million bricks. The Spaniards used coquina shells in Florida 300 years ago when they built Castillo de San Marcus in St. Augustine. Today, limestone-rich shells are crushed and used commercially for building homes and roads.

But man hasn't forgotten that first experience of tasting the animal inhabitating the shell. Mollusks are a very significant part of the seafood industry and a food much in demand. In 1979, over four million pounds of oyster, clam, sea scallop and bay scallop meats were landed in North Carolina. And, this year, calico scallops were harvested off Carteret County for the first time in eight years. Advanced technology in managing and harvesting mollusks increases landings each year.

For species like the calico scallop, North Carolina is the northernmost range. But this colorful mollusk may share its waters with other species from New England or the Caribbean. North Carolina has the unique distinction of being the dividing line between the northern and southern marine fauna. For the serious collector, this means paradise of shells. Dredging, hurricanes and winter storms wash in many offshore mollusks, such as the Scotch bonnet, that would otherwise be inaccessible.

The Scotch bonnet was declared the state seashell in 1965 by the act of the General Assembly. North Carolina honored its early Scotch settlers by choosing this pale-colored gastropod, and became the first state to designate an official state seashell.

From the delicate coquina found on local beaches to the crusty oyster, mollusks and their shells have played an important role in history. Though relatively small in size, these complex animals and their houses still stir our imaginations today.

Calico appears, Renews mystery

For several North Carolina fishermen, 1980 will be remembered for the return of calico scallops and a bountiful harvest. This year marks the first landings of calico scallops in the state since 1973. A mystery mollusk, the calico still creates excitement with each sporadic return.

According to Jim Tyler, information and education coordinator for the North Carolina Division of Marine Fisheries, the only productive calico scallop bed in the state lies 17 miles off Carteret County. "When the exploratory fishing research vessel, Dan Moore, was monitoring the bed and found the abundance," he says, "we of course reported it to the fishermen." The season opened in March, but the supply lasted just a few weeks.

"During the first week," Tyler explains, "approximately twenty boats were working the bed, with more boats coming in. For three days, our records show that approximately thirty-six thousand bushels were brought in, or approximately twelve thousand gallons, which sell for thirty dollars a gallon at the markets."

Photo by Jim Tyler

Loaded down with calico scallops, this boat heads home

The occurrence of calico scallops in North Carolina is still a mystery, according to Hugh Porter, assistant professor of Marine Ecology and Malacology at the University of North Carolina's Institute of Marine Sciences in Morehead City. The major beds are found in Florida off Cape Canaveral and in the Gulf of Mexico. Also, North Carolina is the northernmost range for the calico scallop.

"The calico scallop, when it does occur in commercial quantities off the North Carolina coast, will occur in large, dense beds," Porter says. "We do not know what causes those beds to occur out there. Some of the dealers and fishermen will tell you that once they spawn, they start dying," he explains. "We don't know. We also don't know whether the scallops repopulate

Continued on next page

the area if given a chance to spawn."

"Another theory," Porter continues, "is that our calico scallop beds come up from Florida. The juvenile scallops may be spawned off the Florida coast and brought up to our waters by the Gulf Stream. For some reason, they are dropped out as juveniles here."

The calico scallop beds have been known for years by fishermen, according to Porter. "Years ago," he explains, "they would occasionally bring in some. But, it's only been recently that we have had automatic shucking machines for calico scallops. Up until the advent of these machines, all scallops had to be shucked by hand."

The process patent for the first scallop shucking machine in the state was held by Elmer Willis, a Carteret County seafood processor. In the mid-60's, Willis refined the process for the scallop industry. When the calico scallops are sent through the machine, the first step involves a steam treatment which opens the shells slightly. Then, the shells are agitated vigorously, causing the muscle and viscera to fall out. This part of the scallop then goes through a series of rollers that separate the viscera from the muscle, the part actually eaten.

"There are five to seven shucking machines in the area," Tyler says, "primarily in Carteret County with some in Onslow. Many were running twenty-four hours a day, and I've been told they can produce something like one hundred to one hundred and fifteen gallons an hour. There are still some people Down East actually hand shucking them because you do get more meat. The machine does have a little bit of waste," he says.

In spite of its unpredictable nature and limited supplies, the calico scallop is still a popular catch for both fishermen and seafood processors in North Carolina. Years between harvests doesn't dull the enthusiasm and eagerness generated when a season is finally announced. And, it just may be another eight years before they return to this traditional bed to set.

Reading a clam's life in the rings of its shell

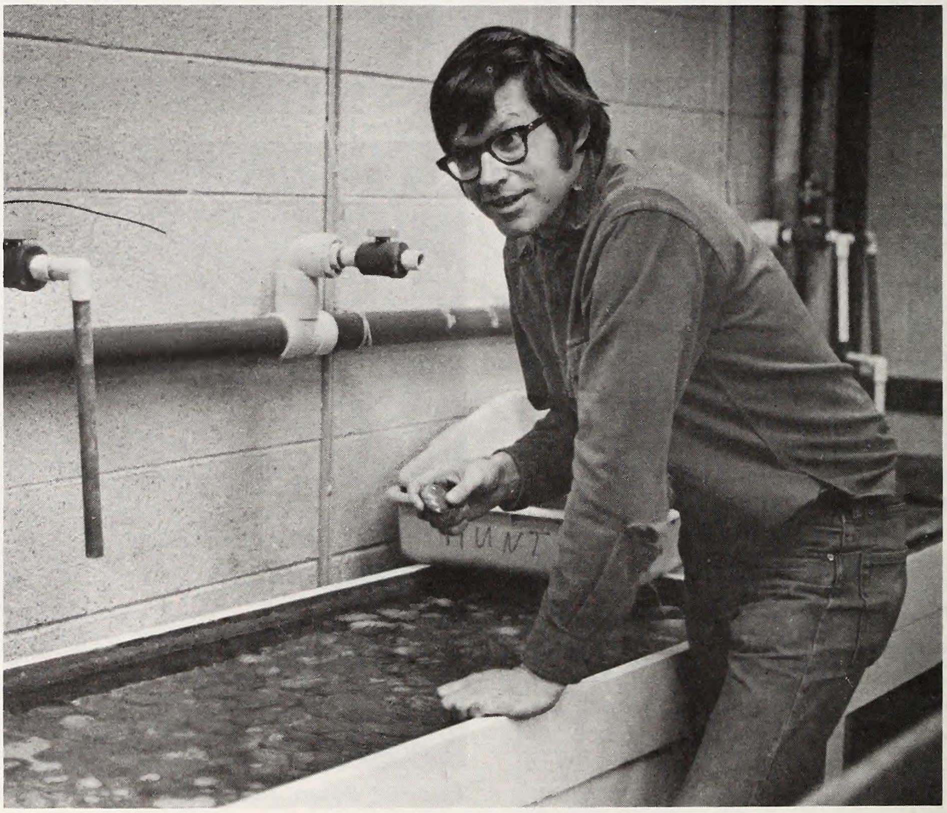
To determine the age of a tree, you count the number of rings in a cross section of the trunk. For each growth period, a ring is added—a thick one for a healthy year and a thin one for leaner times. The rings reveal the tree's life history and the environmental forces it faced. This information can be used in forest management. Using a similar technique, a Sea Grant researcher is recording the life histories of hard clams.

By studying cross sections, Charles H. Peterson has been discovering certain data that can be used in the management of hard clam resources in North Carolina. The harvest of hard clams in North Carolina has increased dramatically in just the last couple of years. Commercial landings of clam meats jumped from 892,000 pounds in 1978 to 1,455,000 pounds in 1979. Demand for seafood is part of the reason, but new means of mechanical harvesting, such as clam kicking, have made deep-water and older beds more accessible to the clammer.

"It has really become imperative," Peterson says, "to address whether we need to worry about managing the stocks and whether we will be able to continue the level of harvest we are currently applying to the population."

With Sea Grant support, Peterson, an associate professor at the UNC Institute of Marine Sciences in Morehead City, has been studying the hard clam in Carteret County for over two years. To find an aging technique, he and his assistants marked clams that were placed under natural conditions and measured them periodically. In the first years of study, approximately 80 percent of the clams displayed a common new growth line. Last year, when the clams were examined again, another new growth line had been added.

Photo by Cassie Griffin

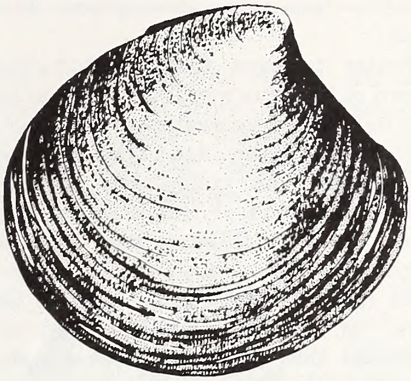


Charles Peterson checking on young clams in the lab

Hard clams, like all mollusks, grow by producing more shell. Calcium carbonate is secreted in the glands of the mantle and laid down periodically as the clam grows. Also, organic materials of different hardnesses are added to the shell during the growth cycle. When Peterson etches his shell cross sections with acid, the areas rich in organics dissolve at different rates and leave a distinct pattern. Peterson describes the etched shell as "a relief map almost like a fingerprint that tells you the different areas and shows you the growth lines."

According to Peterson, the lines revealed in the section display not only annual features, but other physiological and environmental features as well. "You can see daily growth lines on many mollusks, and you can see sub-daily patterns," he explains. "You can even see the rise and fall of the tides. There are lines matching the lunar cycle of spring tides and neap tides. And, there are annual lines as well, coinciding with certain annual events the clam may experience, such as spawning. By collecting at different times, we can also identify the time of year that that feature is laid down in the shell, and that gives you an even more specific marker."

The aging technique used by Peterson is not new, however. It has been used extensively on hard clams, but only in northern areas. There the annual feature, a cold check, is laid down during harsh winter weather. It was believed that aging hard clams wouldn't be possible south of Cape Hatteras in milder climates until Peterson found a similar feature.



"It turns out that we have a summer feature here," the researcher says, "that is an annual event—the heat check. We've just recently collected and analyzed our second-year collection, so we are now quite certain that this is indeed annual and that it's going to be a useful marker and aging technique." It has also been determined that the summer feature is laid down in the Carteret County clams between May and October.

Peterson says his research is needed because there is no basic biological data available for managing hard clam resources. "We've been working on this aging technique so that we can look at the natural populations that are now being harvested by clammers in the state and find out what their age distribution is," he says. "In other words, if people are hauling in, on the average, three-year-old clams, that implies that the renewal rate, the rate at which those clams will replace themselves, is a great deal more rapid than if they are harvesting twenty-year-old clams. That," he continues, "is an important statistic that has been unavailable to people interested in management of shellfisheries in the state, and specifically of the hard clam catch. It's just a question of how long they need to grow into the size class that is legal to harvest."

The man Of 100,000 Seashells

Across the country, when people cite an expert on the subject of clams, mussels or scallops, the expert's name is likely to be Hugh Porter. This man knows his mollusca.

A native of Pennsylvania, Porter came to North Carolina 25 years ago to work on an oyster project under Al Chestnut at the UNC Institute of Marine Sciences in Morehead City. There, Porter discovered some boxes of shells, and his curiosity got the better of him.

"I quickly got interested in some boxes of seashells that no one was paying any attention to," Porter says, "and decided to put them into a collection before they got lost. There was a lot of them I'd never seen before, Well, it has just grown from a continuing and developing interest. Now, I think

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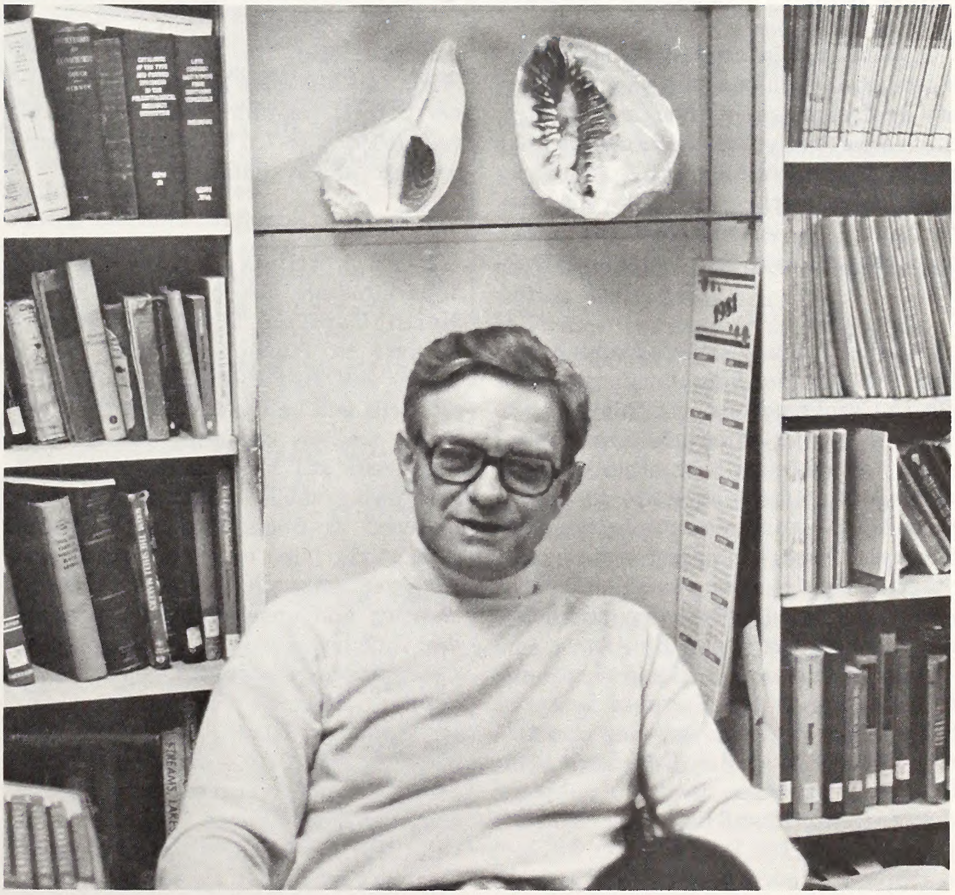
Photo by Cassie Griffin



Hugh Porter at the Institute of Marine Sciences my major interest is trying to understand what molluscan fauna is present in North Carolina waters and in what environmental conditions it occurs."

The small collection at the institute grew over the years with species brought in by commercial fishermen, friends and colleagues of Porter's. Drawers, shelves and boxes of shells were numbered, catalogued and filed, and the assistant professor was named curator of invertebrates. Porter estimates that he now has between 100,000 to 200,000 shells (many still in boxes) with over 1300 different species from around the world. In this vast assemblage are 735 species native to North Carolina, including marine, freshwater and land mollusks.

According to Porter, a seashell is the recorded history of the living mollusk. "You can tell something of under what conditions it's living," he explains, "whether it's recent-living or it's been buried for some time. You can get an idea of what type of environment if you have live shells, such as the northern or southern fauna.

"The reason we have this collection," he continues, "is it serves as a base for any people doing studies. Also, the collection serves as a repository of identified material collected from specific locations throughout the state."

Porter believes that an accurate record of the flora and fauna of an area can define the ecosystem. Currently, Porter is using this idea to define Lake Waccamaw. As consultant on the molluscan fauna of this area for the Bureau of Land Management, he has discovered some new species. "We have in Lake Waccamaw itself," he says, "at least five different kinds of mollusks that occur nowhere else in the world. The most common, a freshwater mussel called the Waccamaw Lance, occurs in densities of forty to sixty per square meter at times. You can hardly walk in parts of the lake without cutting your feet."

The exceptional environment in the lake area comes from its isolation from other water systems, Porter says. When the Carolina bays were split off, lakes like Waccamaw became completely enclosed. "Consequently, the forms that have gotten into the lake have had a long time to develop and become different species. The whole Lake Waccamaw and Waccamaw River area is a small estuary. And, it's just a real interesting and special environment."

Porter doesn't confine his interest in mollusks and seashells to this office in the institute. He and his wife Pinky, also an avid shell collector, are charter members of the North Carolina Shell Club, at whose meetings he often lectures. Vacations frequently take them to places where the shelling is good. Porter has also co-authored the state's only seashell guide book, *Seashells common to North Carolina*, which is published by the UNC Sea Grant College Program.

Field trips, displays and special events

If you are interested in learning more about mollusks and shells, there are several places in North Carolina that offer activities suitable for all ages. This summer when you're vacationing at the coast, take the opportunity to learn something new about some of its oldest inhabitants.

The Hampton Mariners Museum in Beaufort has the largest collection of North Carolina shells on display in the state. Saltwater aquariums also house many live mollusks with other marine animals in natural habitats. In addition, the museum sponsors field trips, lectures, films, demonstrations and other activities year-round. All activities are listed in the calendar which is published every four months.

A popular educational experience at the museum is the Summer Science School for students entering fourth through eighth grades. Organized like field trips, courses range in subject matter from fish and fishing to elemental oceanography. Pinky Porter will be teaching a course on collecting and identifying seashells this summer.

For more information on the museum and its activities, write Hampton Mariners Museum, 120 Turner Street, Beaufort, N.C. 28516, or call (919) 728-7317. Museum memberships are available.

Live mollusks in saltwater aquariums are also on display at the North Carolina Marine Resources Centers at Roanoke Island, Bogue Banks and Fort Fisher. This summer, seashells will be the theme at the Fort Fisher Center, with programs ranging from shell stitchery to collecting and identifying shells. Shells will also be featured at Bogue Banks in several films, field trips and demonstrations. All three centers have staff on hand to identify and answer questions about any shell brought in. For more specific information on activities, contact each center: Marine Resources Center/Roanoke Island, P.O. Box 967, Manteo, N.C. 27954, or call (919) 473-3493; Marine Resources Center/Bogue Banks, Atlantic Beach, N.C. 28512, or call (919) 726-0121; Marine Resources Center/Fort Fisher, General Delivery, Kure Beach, N.C. 28449, or call (919) 458-8257.

One of the state's finest shelling areas is Cape Lookout National Seashore. Park Naturalist Ted Ameen has four regular programs this summer: "lighthouse history talk," "wilderness hike," "exploring the national seashore" and "fish with a ranger." Shelling will be included on some of the walks. Cape Lookout is accessible only by boat or the summer ferry service. For a ferry schedule and more information, write Cape Lookout National Seashore, P. O. Box 690, Beaufort, N.C. 28516, or call (919) 728-2121.

And, if you would like to meet other shell collectors, the North Carolina Shell Club has over 400 members. Membership dues are $5 for adults and fifty cents for students. In addition to scheduled meetings and activities, the club sponsors a biannual shell show. This year's event will be held October 22-24 at Independence Mall in Wilmington. For more information, write the North Carolina Shell Club, Inc., Carolyn Smith, Recording Secretary, 5300 Fair Oak Road, Durham, N.C. 27712.

THE BACK PAGE

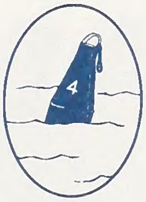
"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).

As summer approaches, many beach communities are gearing up for the rush of tourists. But being prepared for summer visitors means more than opening up restaurants closed during the winter and cleaning up rental property. It also means preparing for the beach accidents that occur every year when you mix folks unfamiliar with beach hazards with elements like rip currents, undertows and intense heat.

That's why Dennis Regan, Sea Grant's recreational advisory agent on Roanoke Island, is organizing beach safety clinics for Dare County emergency personnel. For the first meeting on May 6, Regan invited town and county officials, police, lifeguards, emergency medical technicians (EMTs), National Park Service personnel and personnel from the Outer Banks Medical Center. He hopes these groups can work out a cooperative, county-wide emergency procedure that will provide fast aid for beach victims.

In a second meeting to be held in June, sponsored by the Dare County Chamber of Commerce, Regan and others will acquaint Dare County summer employees with emergency procedures and potential dangers on the beach. These employees, who often have contact with tourists, can pass along information about potential beach hazzards.

And in a final meeting on June 17, those directly responsible for beach safety, lifeguards and EMTs, will be provided with in-depth information for recognizing beach hazzards like rip currents and for following correct emergency procedures.



Divers all over the United States have a new friend to protect them. DAN, or Diving Accident Network, is a 24-hour telephone service designed to help provide quick treatment for the victims of diving accidents.

By dialing 1-919-684-8111, divers are connected with trained physicians on duty 24 hours a day at Duke University Medical Center. Information on the accident is recorded, and the caller is either given direct advice from the physician or information on the nearest regional coordinator. Duke serves the southeastern region, and coordinators of the other six regions in the network are in Pennsylvania, Wisconsin, Louisiana, Washington, California and Hawaii.

Each coordinator has a recompression chamber operated by trained technicians with a physician on call. If that region is unable to help the victim, he is referred to the nearest region that can. Transportation arrangements will be made for the victim if necessary.

So, remember this number next time you go diving: 1-919-684-8111 (collect, if necessary). It could save your life.

Measuring less than three inches long and weighing less than an ounce, tiny elvers can be hard to catch. But this year over 11 pounds or 46,000 of the worm-like creatures were netted in North Carolina waters for culturing at the North Carolina State University Aquaculture Demonstration Project in Aurora. The elvers presently are being held in holding tanks at the facility while they are adapting to special feeds. Later, they will be transferred to grow-out ponds where the eels should reach market size in 10 to 14 months.

Can an eel from New England prosper in the sunny south? Several pounds of Maine elvers arrived at the aquaculture project in April. This year, researchers there will compare the growth rates of the Maine elvers with those of elvers found in North Carolina. The idea is to see whether either group fares better than the other, when both are cultured under the same conditions.

New England fishermen have for some time practiced clam aquaculture successfully. There, a hard clam grows to marketable size in three to seven years. But warmer waters and longer growing seasons in North Carolina enable clam aquaculturists here to harvest in as little as two years. These favorable conditions, plus an increase in prices and a decrease in harvest from natural hard clam beds, have stimulated interest in raising clams here.

To meet the demand for information specifically on North Carolina clam aquaculture, Sea Grant has published *Clam Gardening*. Written by John E. Foster of the NCSU Aquaculture Demonstration Project, this publication gives the interested clam grower an overview of the aquaculture process. Specific information is given on obtaining and raising seed clams, leases and permits, location requirements and management of the garden. The appendix lists additional references and material suppliers.

If you are interested in commercial clam aquaculture and would like a copy of this free publication, write UNC Sea Grant, P.O. Box 5001, Raleigh, N.C. 27650. Ask for publication UNC-SG-81-03.

Continued on next page

Do you know that over 1,000 different kinds of seashells can be found in North Carolina's estuarine and marine waters? Do you know that North Carolina was the first state to designate a state seashell? Do you know what shellfish makes a delicious soup? These topics and many more are covered in the Sea Grant publication *Seashells common to North Carolina*.

Compiled by Hugh J. Porter and Jim Tyler, this booklet is a handy field guide for identifying shells found on North Carolina beaches. A descriptive paragraph on each shell listed gives its range, physical characteristics and locations where it is most commonly found. Photographs or illustrations are also included for most seashells.

Seashells common to North Carolina is available for fifty cents per copy. To obtain this field guide, write Sea Grant. Ask for publication UNC-SG-72-09.

Every fisherman needs good, accurate records to report his taxes and manage his business. So, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service developed a booklet to help the fisherman.

Fishermen's Simplified Recordkeeping Sheets are intended for the fisherman who keeps his own books. Separate sheets are included for trip expenses (fuel, ice, food) and management expenses (payroll, taxes, insurance). Each booklet contains enough account sheets for a full year.

For a copy of this free booklet, write Sea Grant. Ask for Fishermen's Simplified Recordkeeping Sheets.

When recreational fishermen use North Carolina's sounds, they also contribute to local businesses. Expenditures for fuel, ice, bait, tackle, meals and lodging can add up. This summer, they will be asked to contribute in another way—by answering the questions of three Sea Grant researchers.

The researchers involved in the study are Peter Fricke, an East Carolina University sociologist, Leon Abbas, Sea Grant's recreational economics specialist, and James Sabella, a University of North Carolina at Wilmington anthropologist. They will be doing a socio-economic study of sound fishing in North Carolina, collecting data on who the fishermen are, where they are from, how much they spend locally on fishing trips, and the type of fish they catch. This information, the researchers feel, will be useful for local and regional planners in determining the impact of sound fishermen upon their communities.

"please don't let me expire . . ."

We are required by law to periodically purge the list of *Coastwatch* subscribers. If you are a subscriber, you should have already received a postage-paid subscription card in the mail. If you haven't and you would like to continue receiving *Coastwatch*, please send your name and address as soon as possible to *Coastwatch*, P.O. Box 5001, Raleigh, N.C. 27650.

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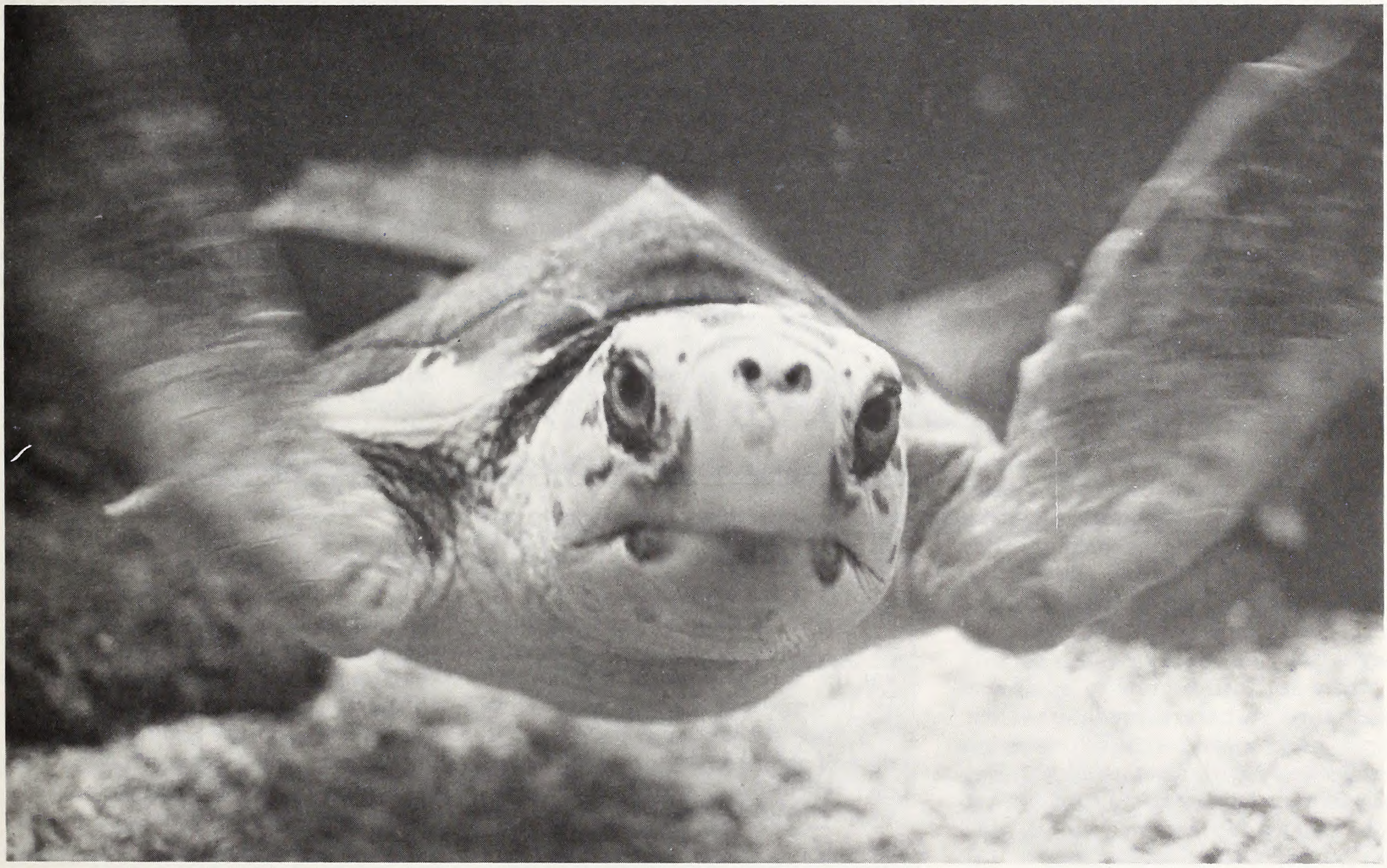


Up close and personal with a loggerhead turtle

Vagabond sea turtles leave scientists mystified

Sea wanderers. From the time they heave themselves from their sandy nests and flap their way to the surf, sea turtles belong to the ocean. They sometimes swim thousands of miles a year.

Much of the sea turtle's life remains a mystery, even to those who have spent years studying the marine reptiles. The sea turtle's life, which can last 100 years, often surpasses that of its human researchers.

And, the sea turtle is a hard creature to track. Once the newly hatched male leaves his nest on the beach he will never again set a flipper on land. The female will visit land after she reaches sexual maturity to lay her eggs.

Tagging the reptiles to follow their movement has presented special problems for scientists. Tracing a loggerhead's movements by satellite was successful in one study, but such techniques are too expensive to apply extensively. Placing metal tags in the female's leathery flippers as they nest is one method of tagging that has proved only fair at best. The turtles often lose the tags. Also, scientists can only tag the females. But using this method, researchers have found that

Continued on next page

many female turtles will return to the same beaches repeatedly to lay their eggs. Some scientists believe the mother is even returning to her own beach of birth. But Debbie Crouse, coordinator of the N.C. Wildlife Resources Commission's project for sea turtles in North Carolina, says evidence to support that belief is not conclusive. Until scientists can find a tag that will expand or remain attached to the turtle from the time it hatches until adulthood, she says, no firm conclusions can be made.

Frank Schwartz, a biologist at the UNC Institute of Marine Sciences who has been studying turtles for 25 years, says he has developed a tiny square metal tag, containing information about where and when the turtle hatched. The tag can be inserted under the skin of the turtle's flipper. It should remain with the turtle throughout its life, Schwartz says.

But other researchers say the drawback to this method is the bulky X-ray equipment needed to detect the tags.

But some method must be developed that will fill the gaps in our knowledge of the sea turtle's life. Crouse says once the hatchlings leave the beach, researchers totally "lose track of the turtles" until they become large enough to get caught in fishermen's trawl nets. Schwartz says he believes the loggerheads spend the first year of their life floating and feeding off sargassum weed. "But after that we just don't know what they do," he says.

Once sea turtles grow to adult size they have few natural predators. Their hard shell provides the protection needed to fend off most assailants. But scientists believe that sea turtles must rely largely on instinct to survive. With a brain the size of a grape, a turtle has little room to think.

Most turtle researchers think the turtles reach sexual maturity between the ages of 13 and 20. The loggerhead, the only sea turtle that consistently nests in North Carolina, mates ½ to ¼ mile offshore. The male rides the female for several hours as they mate, fertilizing the eggs she will lay that summer. About two weeks after mating, the female loggerhead will come ashore to lay her first batch of eggs. The mother turtle may lay two to three more nests during the same summer. An average nest contains about 120 leathery white eggs.

In recent incubation studies, Schwartz and other researchers have learned that the sand temperature in which the turtle nests affects the hatchling's sex. Cooler sand temperatures yield males, while warm temperatures hatch more females. Schwartz says more males are hatched in the cooler nests of early and late summer, but females dominate in the warm mid-summer nests.

The loggerhead turtles will hatch in about 60 days. They use an egg tooth attached to their snout to chisel their way out of the shell. Most of the eggs hatch about the same time because the turtles must work together to escape their nest. "The turtles work as a unit," says Charles Peterson, wildlife management supervisor at the U.S. Marine Corps base at Camp Lejeune. "The hatchlings at the top of the nest scrape and shift the sand downward while the ones on the bottom pack the sand, building a rising platform."

The baby turtles usually emerge at night or early morning. Then they begin their scramble to the sea. But the soft, vulnerable hatchlings make easy pickings for ghost crabs and sea gulls. Only a few hatchlings make it to the surf, and then they must evade large predators like sharks and bluefish.

What are the turtle's chances for survival? Schwartz cites this example: "There were 63 nests last year at Camp Lejeune. About 70 percent of the eggs from each nest will hatch. About one hatchling per nest will make it across the beach to the surf. That's 63 altogether to the ocean, and of that number only half, or 32, will make it past the sharks and bluefish. So, out of 7,000 eggs, you may get 30 adult turtles."

Schwartz and other scientists are working on incubation methods and head-start programs that may increase the survival rate of the endangered sea turtles. But more must be known about these reptiles before scientists can say any program will help.

"I'd rather not know everything there is to know about sea turtles. I like some of the mystery about the creatures," says Riley Hoggard, a park technician at the Cape Lookout National Seashore. "But if there is a chance they will become extinct, I want to know everything I can to help them."

A ritual in the night

The wee hours of a June morning find a mother loggerhead emerging from the surf to perform a ritual. At least it seems like a ritual, because so many loggerheads have performed it before in almost exactly the same way. The mother loggerhead has come ashore to deposit her first cache of eggs.

Those who have watched the loggerhead perform her egg-bearing duties say the performance is a grand one, and well worth sacrificing sleep to catch the opening curtain.

"It is indeed impressive," says Debbie Crouse. "It's very late at night on a beach in the middle of nowhere and you suddenly see this four hundred-pound creature hauling out of the water. You see her expending all this energy just to pull herself forward. It's like watching something prehistoric."

And the sea turtle indeed has prehistoric ties. Dating back about 150 million years, the sea turtle may be linked to a giant land turtle that roamed with dinosaurs. Scientists speculate that when the turtle took to the sea, its feet gradually changed to flippers, the body became more streamlined and the bony shell covering its underside became smaller. After the initial changes, scientists say sea turtles changed very little. Today's sea turtle may look very much like its ancestors thousands of years ago.

"What struck me the first time I watched one lay her eggs," says Sally Hopkins, a biologist with the South Carolina Wildlife and Marine Resources Department, "was you saw this form in the darkness, then as she pulled herself further out of the water you saw these twinkling lights all over her shell from the phosphorescence and organisms growing on the turtle's back. It was so magical."

As the mother turtle lumbers from the surf, dragging her tremendous body toward the dunes, she stops here and there along the way—some say to rest. But others say that if you watch the loggerhead closely she will prod the sand with her nose as if to test it. Recent research suggests that may be exactly what she's doing. Scientists believe the turtle is testing the sand's moisture content, grain size and temperature to find just the right spot for her eggs.

The turtles are skittish creatures. Unusual sounds and lights will turn the mother turtle back to the sea, leaving behind only her tracks, called a "false crawl." But she will usually emerge from the ocean again.

Once a mother turtle has begun digging her nest and laying her eggs she can not be deterred from her task by any amount of noise or light. After choosing the right place, the turtle backs up to her spot and digs her nest with her flippers.

"She swishes the sand back and forth with her back flippers," says Hopkins. "You can hear her flippers working. As she begins to dig deeper she scoops the sand with first her right and then her left flipper as she digs out her hole. She's very dexterous with those flippers. They're like hands."

The loggerhead will dig a nest about 18 inches deep into the base of the dunes, just above the high tide mark. She forms the nest in the shape of a flask. "As the turtle completes her digging, she urinates on the sides of the cavity," Crouse says. "The moisture allows the turtle to pack the sand and shape it the way she likes."

Crouse says researchers are unsure about the significance of the shape of the nest. Some scientists believe the shape may aid the hatchlings in climbing out of the nest. Or, it may keep the nest from becoming too packed. Until some answers are found, Crouse believes only nests in danger of destruction should be moved.

When the digging and the shaping are complete, the turtle plunks the eggs into the nest two and three at a time until about 120 fill the cavity.

Once her task is complete, the turtle begins sweeping sand in the hole, Hopkins says. "Then she rouses up and plunks her body down on top of the nest like she is packing down the eggs. Finally she crosses her back flippers and gives the nest a little 'umph'. She moves away, throwing sand with her front flippers over her back to cover the site."

The mother turtle then labors back to the sea.

Photo by Ken Taylor

A mother turtle dutifully lays her eggs

Turtles' survival threatened

Can a creature who survived the age of dinosaurs to live 150 million years survive the age of man? The question has provoked scientists and management officials to try and save the dwindling populations of endangered and threatened sea turtles.

Off the North Carolina coast, five types of sea turtles can be found in varying numbers—the green turtle, the loggerhead, the leatherback, the hawksbill and the Atlantic ridley. The green and loggerhead turtles are listed as threatened under the U.S. Endangered Species Act while the leatherbacks, hawksbills and Atlantic ridleys are listed as endangered. Those species listed as endangered are the ones scientists believe will probably become extinct unless changes are made. Threatened species are in less trouble, but they could easily become endangered if their populations are not revived. Many experts believe the Atlantic ridley is just a step away from extinction.

Many factors have led to the demise of sea turtles, but probably the most critical problem has been the overdevelopment of beaches. Areas where the turtles once nested in solitude are now clustered with motels, condominiums, amusement parks and people—not exactly choice spots for a cache of 120 sea turtle eggs.

Not only is overdevelopment robbing the adult sea turtle of its nesting grounds, but it also is causing serious problems for hatchling turtles. After pecking their way out of their shells and unearthing themselves from their nests, usually at night, they head for the ocean—perhaps drawn to the gleam on the water. But Frank Schwartz says the tiny turtles can easily be lured off track by other light

Continued on next page

sources—street lights, motel and house lights and car lights. Wandering baby turtles become the victims of ghost crabs, sea gulls and the heat of the sun.

Besides being easily drawn astray by lights, hatchlings have another obstacle between the nest and sea—off-road vehicle (ORV) tracks. To a baby turtle the size of a half-dollar, climbing out of an ORV track can be like scaling a 10-foot wall for you and me. Riley Hoggard says the problem is particularly acute along the park service beaches where ORV driving is allowed. "They get caught in the tracks and they can't get out," he says. "They end up following the vehicle's path parallel to the beach and that just gives them more time to be prey for the ghost crabs and the sea gulls."

Paul Hosier, a biologist at UNC-Wilmington who has been doing Sea Grant research on ORVs, confirmed that ORVs are indeed a threat to the small hatchlings. In a study at Ft. Fisher, Hosier marked off three beach areas—one area undisturbed, one area marred by a three-wheeled ORV, and a final area heavily trampled by people. He then released 40 hatchlings. Of the 16 that passed through the undisturbed area, all made it to the surf. In the ORV area, 11 of 13 hatchlings trudged their way to the sea, while in the area trampled by people only six of 11 finished crossing the beach.

Of those hatchlings that did not make it to the surf, over half became inverted and could not right themselves, becoming easy targets of prey, Hosier says. Also, he notes that those hatchlings that crossed the undisturbed area moved at a much faster pace than the hatchlings that had to crawl in and out of the valleys left by vehicles and people. The faster the movement to the surf, the lower the predation rate, he says. (Note: No turtles died in this experiment. All turtles that became inverted or lost their way among the tracks were picked up after an allotted time and transferred to surf.)

But sea turtles are sometimes in trouble only seconds after they leave their mother's body as eggs. Raccoons and foxes often hover in the shadows as a female loggerhead nests, waiting for a midnight snack of eggs. Raccoons are particularly voracious, as they can gobble down an entire nest of eggs in just minutes. Schwartz says many of the raccoon's own natural predators have been eliminated with development, causing their populations to boom. And raccoons along Onslow Beach and Bald Head Island are creating havoc with the loggerhead nests.

Charles Peterson says the nests at Camp Lejeune are being protected from predation by wire baskets. Peterson's assistants patrol the beach at night during nesting season, watching for the turtles to nest. As the females complete their tasks, the assistants cover the nests with the baskets. Peterson says the baskets are built of wide-mesh wire that allows the hatchlings to crawl away.

Peterson and the marines at Camp Lejeune aren't the only ones in North Carolina tracking and aiding sea turtles. Programs are also going on at the Pea Island National Wildlife Refuge, the Cape Lookout National Seashore and Hammocks Beach State Park.

Debbie Crouse, who is on loan from the N.C. Heritage Program to the state Wildlife Resources Commission, is coordinating a statewide sea turtle nesting survey. The Wildlife Commission is paying to have the state's coastline overflown regularly to detect turtle crawls. Crouse takes this information and coordinates it with the ground surveys being done by the other agencies. With the results, Crouse hopes to determine key nesting beaches and, eventually, put together a cooperative state program for the turtle's protection.

On a national level, the National Marine Fisheries Service has appointed a Sea Turtle Recovery Team. Otto Florschutz, a U.S. Fish and Wildlife biologist in Washington, N.C., is part of that team. He says the team is trying to draw up a management plan that will restore the sea turtle populations so they will no longer need to be protected.

But while programs in the U.S. fight to save sea turtles, many other countries continue to exploit the marine reptile. Many turtles, especially the green turtles, are still killed for food in parts of the Caribbean, Mexico and Central and South American. The hawksbill is slaughtered for its shell, which is used to make tortoiseshell combs, jewelry, brush handles and eye glasses. And, experts say, until other countries take a stand for conservation of the sea turtles, the age-old reptile will remain in trouble.

Photo by U.S. Marine Corps

Baby green turtles at Camp Lejeune waddle from their nest

Turtle-proofing Fishing Gear

One warm afternoon, a foul stench drifts in the wind along an Onslow County beach. A couple of hundred yards up the beach lies a 200-pound, decaying loggerhead turtle, bloated and matted with flies.

Last summer 102 sea turtles, mainly loggerheads, were found dead along North Carolina beaches. The numbers were even higher for other southeastern states where turtles are more numerous—693 in South Carolina, 656 in Georgia and 217 along the east coast of Florida.

No one is sure why most of these turtles died. But the deaths made a significant cut in already dwindling populations. Some speculate many of the turtles died after drowning in fishermen's trawl nets and gill nets.

Richard Seely, a commercial fisherman from Marshallberg, says he averages catching three or four turtles in his nets during the shrimping season every year. "That may not sound like a lot," he says. "But when I can count as many as 85 boats trawling in the same area and you start multiplying those numbers, well, that can be a lot of turtles."

Seely says most of the turtles he pulls up in his nets can be revived and returned to the water. But occasionally, he says, he finds one that is dead.

"They just get caught in my net as I'm towing," he says regretfully. "I can't tell when they get in there. It's not my fault and it's not the turtle's fault."

Chuck Oravetz of the National Marine Fisheries Service (NMFS) agrees that fishermen should not be blamed for all the sea turtle deaths. "It's a gross error to think that all stranded turtles are a result of fishing activities," he says.

To help fishermen bar the reptiles from their nets, NMFS has been developing a sea turtle excluder device to be used in their trawls. After careful testing, NMFS came up with a design that is low-cost ($200 or less) and easy to attach to existing trawl nets. Oravetz says the excluder device eliminates 90 percent of the turtles usually caught and also eliminates sponges, logs and "cannonball" or "cabbage head" jellyfish.

Photo by Kathy Hart

Chuck Oravetz demonstrates miniature excluder device

Shaped like a wide funnel, the excluder has diagonal back and side bars that are three to six inches apart. The device is sewn inside the trawl at the intersection of the trawl body and the tail bag. As a turtle or any other large object enters the bag, it strikes the diagonal bars and is forced downward toward a trap door that is set to release heavy objects. The trap door closes after the turtle is released. Shrimp and other small objects will pass through the bars and into the tail bag.

The excluder will have several advantages that should sell the fishermen on its use, Oravetz says. "It will save turtles, eliminate heavy byproducts, reduce sorting time, cut down on crushed shrimp and allow longer towing times," he says.

Oravetz says some fishermen voluntarily used the excluder devices during last year's shrimping season and more are expected to give it a try this summer. He and other NMFS officials are traveling the southeastern coast this spring to demonstrate the device through video tapes and models. (They demonstrated the excluder in North Carolina for Sea Grant agents in early April. You can contact your nearest agent for further information about the device.)

In another effort to save sea turtles last year, the NMFS enacted 240-day emergency regulations for reviving comatose sea turtles that are in shock and may appear dead. Under the emergency regulations, fishermen are asked to place a comatose sea turtle on its breastplate and elevate its hindquarters. Oravetz says this is a better method of resuscitation than the older method of placing the turtle on its back and pumping its breastplate.

All turtles, dead or alive, must be returned to the water. Fishermen who take turtles can be fined $20,000 by NMFS.

To help sea turtles in North Carolina, the state Marine Fisheries Commission designated a sea turtle

Continued on next page

sanctuary that extends from Bogue Inlet to New River Inlet, the only sanctuary like it in the nation. The waters in this area are closed to shrimping from June 1 to September 1, beginning this year. The sanctuary extends ¾ mile seaward, except along Bear Island and northern Onslow Beach, where it only extends 1000 feet offshore. Fishermen expressed little opposition to the plan after the commission reduced the closed area just off Bear Island, a prime shrimping ground.

Frank Schwartz, who requested the sanctuary's designation, says that closing the areas to shrimpers means more turtles are likely to make it to the prime nesting beaches the sanctuary protects.

If a dead turtle does wash up on the beach, federal officials want to know about it. You can report the stranding by calling a toll-free number (1-800-327-6545).

More and more steps are being taken to protect sea turtles as more people realize their plight. State and federal fisheries officials are hoping their efforts to aid the sea turtles will help to cast away some of the gloom surrounding their future.

Turtles, tears And tall tales

For the ancient Hindu philosophers, the world began with a gigantic sea turtle, swimming in an endless ocean with four colossal elephants on its back. Upon the elephants' backs rested the earth.

With a legacy of about 150 million years, sea turtles have had plenty of time to kindle the imaginations of man in folklore and fantasy.

Even Alice in her trek through Wonderland met a part-turtle, part-calf creature calling himself Mock Turtle. Mock Turtle sobbed constantly, but, in nature, it's the female turtle that sobs. All mother turtles cry as they lay their eggs—not from pain or distress, but only to wash the salt from their eyes. But, legend has it that the sea turtles were once land creatures banished to the sea because of some misdeed. Now, the story goes, as the females return to the land to lay their eggs, they cry because they, and eventually their young, must return to the sea.

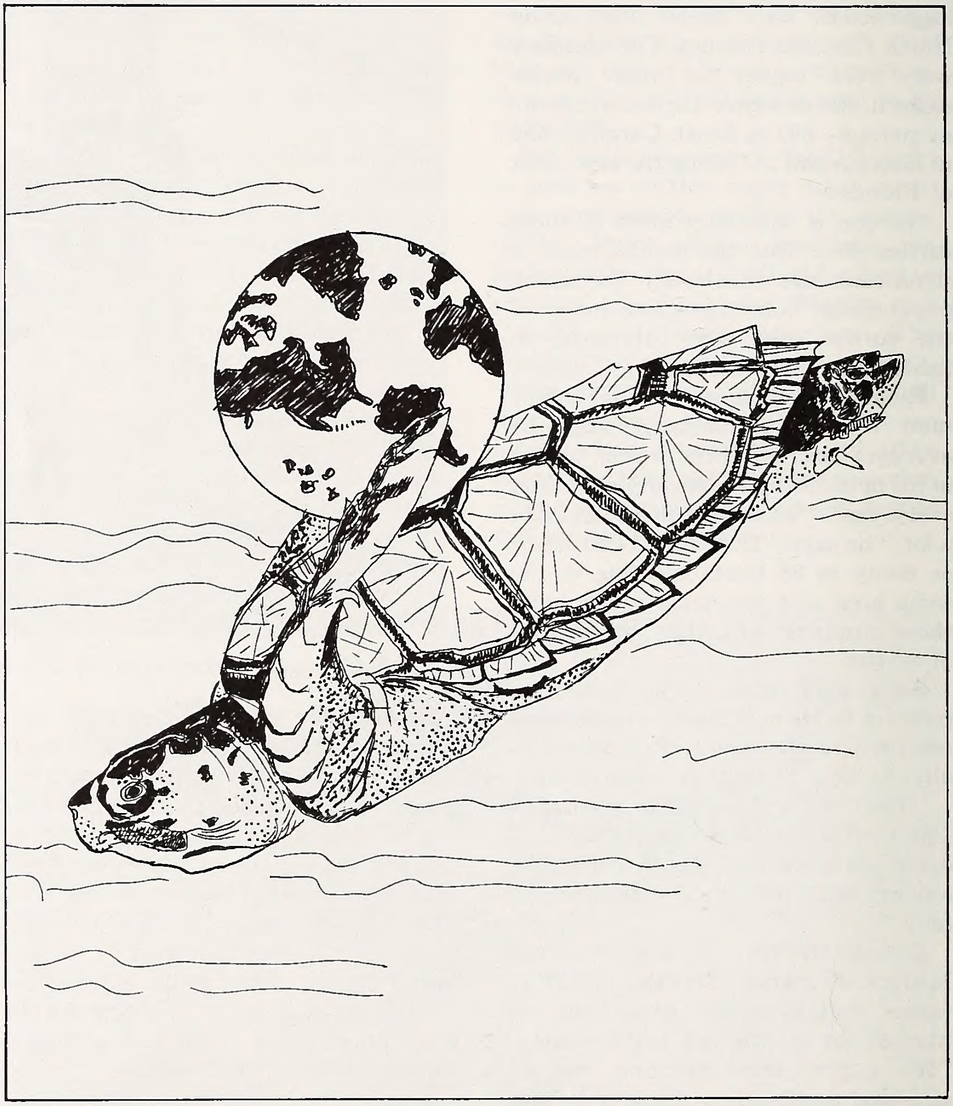
Another tale frequently told about loggerhead turtles is that they nest on the full moon. The turtles will actually nest under any phase of the moon, according to those who have spent time watching for the reptiles. More likely, it's the people who are more active on the full moon.

Speculation has always abounded about why the sea turtles nest when they do. In Costa Rica, on the beaches of Tortuguero where green turtles nest in large numbers, Jack Rudloe turned up a legend among the Costa Ricans about a turtle rock. In his book, *Time of the Turtle*, Rudloe tells the story about a rock, shaped like a turtle with a head and flippers, buried in the cave of a mountain. For most of the year the turtle rock faces the ocean. But during June the rock turns and faces the land as a signal for the turtles that it is time to nest. In September the rock revolves again—nesting is over. Some of the natives claim to have seen the rock, while others say the turtle rock is just a myth passed down from earlier generations.

Another yarn that has been more widely broadcast is that of the sea turtle egg being an aphrodisiac. A market once thrived on selling the eggs to stimulate sexual appetites. But the legend has no truth and probably originated because turtles lay so many eggs.

So many questions linger about sea turtles that it is sometimes hard to sieve the fact from the fiction. If the sea turtle does carry a world on its back, it is a world of mystery.

Drawing by Tina Bromberg



Carrying the world on its back, this fictional sea turtle swims forever.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).

Sea Grant's advisory agents will be taking advantage of warm weather and good fishing conditions during the summer to teach some folks to fish.

Dennis Regan, recreational advisory agent on Roanoke Island, will be conducting pier fishing classes every Wednesday from June 24 until the end of August. The classes will be held from 9 to 11 a.m. each week and will alternate between Jeannette's and Nags Head piers, beginning with Jeannette's Pier June 24. Those interested must preregister by calling (919) 473-3937. Equipment will be supplied, but participants must buy their bait.

After casting from the piers of the Outer Banks during the morning, you can learn how to cast in the surf during the afternoon. Regan also has set up surf fishing classes for 2 to 3 p.m. every Wednesday from June 24 to the end of August. James Hasty, a bait and tackle owner, will teach the classes, which will be held outside his shop in Nags Head. Bring your own gear if you want to ask questions about it or try some of your new knowledge after the class.

Bob Hines, Sea Grant's marine advisory agent at Bogue Banks, also will hold a surf fishing class this summer. To be held June 23 at the Bogue Banks Marine Resources Center, the class begins at 11 a.m. and will be followed by a surf fishing field trip to a nearby beach. The class is free, but those going on the field trip should bring their own gear.

At the Ft. Fisher Marine Resources Center, Debbie Ford of the Sea Grant staff will be offering surf fishing classes for youngsters, ages 9 to 12. Ford will show the youngsters basic knot tying, casting, baiting and surf fishing. All materials for the class are supplied, but the children are required to wear shoes. Ford will be holding the classes June 16 and 26, July 10 and 28 and August 11 and 25 from 10 a.m. to noon at the Ft. Fisher Marine Resources Center. Parents must preregister their children by calling (919) 458-8257.

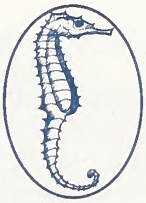
Bad weather is his business. John Sanders, UNC Sea Grant's new coastal weather awareness specialist, will be working with North Carolina coastal communities to plan ways to protect lives and property against severe storms like hurricanes and northeasters.

In his work, Sanders will help state and local agencies develop and improve their weather disaster plans. He will also present workshops designed to help people better understand the hazards of severe weather, and how they can protect their property.

Sanders will be applying some of the knowledge he learned while gathering information for his master's thesis at the University of South Carolina. For his thesis, Sanders assessed the hurricane preparedness of Myrtle Beach, S.C.

If you would like to contact Sanders, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650 or call (919) 737-2314.

Are you a wave watcher? You can learn the dynamics of beaches and waves by becoming a "wave watcher" with Spencer Rogers, UNC Sea Grant's coastal engineering specialist. Rogers will give three talks on wave dynamics this summer at the Ft. Fisher Marine Resources Center outside Wilmington. The talks are scheduled for 1 p.m., June 18, July 16 and August 6. Rogers will begin his discussion by showing participants how waves work in an indoor wave tank. Then the group will move to the beach to observe the real thing.



Outer Banks residents and visitors can become a little richer in their knowledge of the coast this summer by attending a series of talks about the Outer Banks. Dennis Regan, the Sea Grant recreational advisory agent on Roanoke Island, has organized the discussions, drawing on local and field experts to talk about everything from peat mining to beach safety.

The talks will be held at the N.C. Marine Resources Center/Roanoke Island at 8 p.m. each Thursday from June 25 until the end of August. Area residents and visitors are invited to attend the free talks.

Discussion leaders and topics are:

June 25—John Sanders, Sea Grant's coastal weather awareness specialist, on hurricane hazards;
July 2 —Dennis Regan on beach safety;
July 9 —Bonnie Woodall, outdoor recreation coordinator for the Pea Island National Wildlife Refuge, on summer wildlife in the refuge;
July 16—Henrietta List of the N.C. Nature Conservancy on flora and fauna of Nags Head Woods (followed by a field trip July 17. To pre-register call 473-3937);
July 23—Spencer Rogers, Sea Grant's coastal engineering specialist, on hurricane-resistant construction;
July 30—Herb Crase, U.S. Forest Service, on native Indian culture explored through artifacts;

Continued on next page

Aug. 6—Jim Smith, N.C. Department of Natural Resources and Community Development, on peat mining in coastal North Carolina;
Aug. 13—Joe Malat, local fishing guide, on surf fishing techniques;
Aug. 20—Arthur Hurme, ecologist, on shoreline erosion control using marsh plants;
Aug. 27—Bill Birkeneier, civil engineer for the U.S. Army Corps of Engineer's Coastal Research Center, on activities at the coastal engineering research pier at Duck.

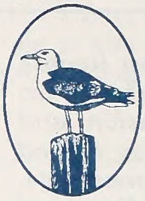
UNC Sea Grant has two new "Blueprints" about eels and eel farming to add to its growing stock of eel publications. The first publication, *Eel Farming—Are You Prepared?* by W.L. Rickards, J.E. Foster and W.R. Jones, provides a list of questions about things prospective eel farmers should consider before launching into aquaculture. To receive this free publication, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650. Ask for UNC-SG-BP-81-2.

The second publication, *Onshore Holding Tanks for Eels*, by W.L. Rickards, describes the major factors you should consider when building a holding tank for eels. The Blueprint also provides a diagram of an eel holding tank, showing essential features needed to keep the eels alive and healthy. For this free publication, write UNC Sea Grant. Ask for UNC-SG-BP-81-3.

Other eel publications available are: *The Case of the Slippery Eel* (UNC-SG-75-20), a guide to harvesting, handling and marketing wild eels; *To Eel or Not to Eel* (UNC-SG-77-02), an economic analysis of a part-time eel fishing enterprise; *How to use Eels as Bait* (UNC-SG-80-01); *A Feeding Tray for Use in Eel Farming* (UNC-SG-78-04); *A Diagnostic Manual of Eel Diseases Occurring under Culture Conditions in Japan* (UNC-SG-78-06—$9 for all requests); *and Techniques of Eel Culture in Greenhouses* (UNC-SG-WP-80-1—$2 for all requests). To request any of these publications use the publication number. Include the fee as noted.

Eel fishing demands its own special gear and techniques. If you're interested in eel fishing, plan to attend a UNC Sea Grant workshop in May. Designed for fishermen new to eel fishing, the workshop will be held May 20, at 7 p.m. at the Jarvis Restaurant in Swanquarter. Sea Grant advisory agents and seasoned eel fishermen will acquaint fishermen with different types of eel pots, eel bait, pot handling gear, fishing techniques, holding and handling methods, markets and the economics of the eel fishery. For further information about the workshop contact: Hughes Tillett at the Marine Resources in Manteo (919) 473-3937, John Foster at the NCSU Aquaculture Demonstration Project in Aurora (919) 322-4054 or Bob Hines at the Marine Resources Center at Bogue Banks (919) 726-0125.

Sea Grant advisory agents are planning another eel fishing workshop for the Wilmington area later this summer.



To get the latest word on marine research a group of North Carolina educators met in Greenville recently. The seminar, called "Bridging the Gap: Marine Information Update," was attended by marine education coordinators and educators, public and private school science coordinators and the information staff of the state Division of Marine Fisheries.

According to Lundie Mauldin, Sea Grant's marine education specialist, the purpose of the seminar was to translate marine research information for use by the general public. Educators and information staff, she says, often don't have the time to keep up with the latest developments in coastal research.

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COASTWATCH

Photo by Gene Furr

On the narrow and delicate barrier islands, it's a case of too little soil for too many gallons

A problem of plumbing

The reader was troubled: He and his wife had just been vacationing on one of North Carolina's barrier islands. "We asked two questions while we were there," he wrote. "One was, 'where does the drinking water come from?' The only reply we ever heard was, 'out of the ground.' "

His other question had to do with where the water had gone when he was through with it. He never did manage to get an answer for that one. If he had, it would likely have been, "right back into the ground." Or, "into the sound."

He had happened on what may be coastal North Carolina's nastiest problem. It's much more than a question of bad plumbing. It's more, also, than a problem of 316,858 acres of contaminated oysters and clams. It's more than a threat to the purity of drinking water. It's more than a stranglehold on new construction. In many places, it's getting worse. And, the authorities in charge can't agree on how to fix it.

There are no easy solutions to the problem of sewage disposal in coastal North Carolina. The environment here is fragile, the desire to build and live here is compelling. In this issue, *Coastwatch* examines the question: What do we do about the stuff we're flushing down our drains?

Ringside at the battle of The Loophole

The malady has been diagnosed, but some say the patient may expire before authorities stop feuding and agree on how to treat it. Much of coastal North Carolina is fouling itself with the flushing of its toilets.

There are no fewer than four heavyweight agencies in the fray: the N.C. Division of Environmental Management, the N.C. Division of Health Services, the Coastal Resources Commission and the U.S. Environmental Protection Agency. Each claims to champion the same cause: protecting the environment and ensuring the welfare of the population.

The main event has been billed as the "health departments versus the state." County health departments, under Health Services, are battling Environmental Management for the authority to govern sewage disposal in their communities. Presently, construction of a sewerage system with a capacity larger than 3,000 gallons a day requires a permit from Environmental Management. Permits for smaller systems are let by local health departments.

Both sides are bitter over what editorial writers have described as "The Loophole." The Loophole allows some builders to skirt authority and construct waste-disposal systems.

State Environmental Management officials say The Loophole exists because local health departments don't stand up to local building interests. "Local health departments are a lot more subject to local pressures," says Stan Taylor, Environmental Management's acting coordinator for permits and engineering. "After all, many of these water-quality problems came about because they weren't handled locally."

Taylor says that in many growing coastal communities, condominium complexes and other developments are avoiding Environmental Management's structures by providing each living unit or building with its own septic tank. Local health departments can issue permits for dozens of septic tanks in these cases, he says, since no one system exceeds 3,000 gallons. Environmental Management, he says, won't allow more than three living units or 1,200 gallons of septic-tank effluent per acre.

"We have a density requirement on septic tanks that is considerably less than what local health departments allow," Taylor says. He says that biological sampling in waters adjacent to concentrations of septic tanks almost always yields high levels of coliform bacteria, regarded by law as the indicators of health hazzards in drinking water and shellfish.

"Wherever you have this rampant development with septic tanks, you're going to find closed shellfish waters," Taylor says.

Page Benton, chief of the division's environmental operations section, says the 3,000-gallon threshold represents an arbitrary attempt on the part of the

Photo by Neil Caudle

Alton Rouse and son

'You can't drain Water in water'

Few are closer to the soils of Carteret County than Alton Rouse and his son, Alton Rouse, Jr. Each year they install or repair several hundred septic systems on sands, clays and even dredge spoil. Too many of those systems, they believe, are bound to fail. They also believe that the public is not really aware of the problem.

"A lot of people come down here to live and don't even know they have a septic tank," Rouse, Jr. says. "You can ask them, and a lot of times they say, 'No, I don't have a septic tank.' But they do, most of them, and they need to know how it works."

With 12 years of experience in his father's septic tank service, Rouse, Jr. believes a properly sited septic tank is the best way to dispose of residential waste.

"You find systems that work thirty years without a minute's trouble," he says. "Some never work at all."

state legislature to define the responsibilities of the local health departments. New housing patterns in the coastal area, he says, are making the rules obsolete.

"There are places in the state where the interpretation is that you can have as many living units in an area as you like, so long as each unit doesn't exceed the 3,000 gallons," Benton says. "In some places on the barrier islands, there are fifteen to twenty living units per acre. That's up to fourteen thousand gallons per acre per day of untreated sewage."

Benton and others point out that because coastal sands are porous, sewage can drop through the soils so quickly that almost no treatment occurs. As long as the effluent doesn't rise to the surface, few people notice the system is failing. Finding out just how much sewage finds its way into drinking water in beach communities is extremely complicated.

Benton says his division's density guidelines are none too strict for the water-laden soils of barrier islands, where most of the drinking water comes from the freshwater "lens" formed when rainwater is trapped underground in a dish-like container of heavier salt water.

"Twelve hundred gallons per acre per day of untreated sewage is equal to about half the amount of rainfall, per acre, that it takes to recharge the drinking water on the barrier islands," Benton says. "Do you want to drink one-third sewage and two-thirds water?"

Benton does not regard septic tanks on the islands as providing sewage treatment— only disposal. He says sewage in sensitive coastal areas should be fully treated before it is released from the system. And he criticizes the methods of some sanitarians, who approve the systems, he says, by "going out to the site, and stamping their feet in the dirt, and saying 'okay, this is approved.' "

But the Division of Health Services and many local sanitarians blame Environmental Management for The Loophole. Joe Stokes, health director in Dare County, says that his county's sewage disposal laws are stricter and more effective than those of Environmental Management.

"How can somebody sitting up in Raleigh decide the best system for a site down here?" he asks. He cites the example of a sewage-disposal plan approved by Environmental Management for a new condominium complex, near Nags Head. The complex's plan to pipe its 10,000-gallon-a-day sewage flow into the treatment plant of a neighboring community outraged some of the community's residents.

Density, with septic tanks

"When the lots were sold here, we thought our sewage plant was large enough to allow for some leeway," says Lourana Cowan, resident of the community. "But since then, they've added all these apartments and restaurants, and now, these condominiums. There have already been some problems with some sewage back-up here, so how can we handle more?"

Continued on next page

He adds that it's easy to predict which system will fail: "You can tell sometimes before you ever start digging. If the lot is low and wet, it'll never work. You can't drain water in water. If you dig down and the water is down there, eight or ten inches, it'll never work. And that blue-looking stuff that they dredge up off the bottom, it's not going to work in that, either."

The problems are worst on the islands, he says, because of the small lots and high water tables there. "The worst are those lots on the canals. I can show you two trailer parks over on the island (Bogue Banks) where not a single system is working. When the tide comes in, and they flush the toilet, it just doesn't flush."

The Rouses will install, for the typical house, a 1000-gallon tank and 100 ft. of drain line for about $650, the usual system for well-drained, sandy soils. On clay, which absorbs effluent much more slowly, the drain line is lengthened to about 210 ft. and the price rises to around $900.

But in the developing beach communities near them, many of the lots are so small that the Rouses say they can't always find room for the pipe required.

"You take a lot, five thousand square feet, put a house and a driveway on it, come back a hundred feet for the setback and ten feet from the lot boundaries, and there's just no place for the drain field," Rouse, Jr. says.

The Rouses don't lay all the responsibility for the failures of septic systems on the county health department.

"The sanitarians are under a tremendous pressure to approve these things," Rouse, Jr. says. "If a guy has had his lot for five or ten years, saving up to build, are you just going to tell him, 'Hey, you can't build here?' "

Permits have already been issued when the Rouses are called in, but they usually speak up when they see a site won't support the system.

Says Alton Rouse: "I tell the contractor, 'I don't know how you got your permit, but this ain't gonna work.' Then it's up to him, if he wants to go ahead."

—Neil Caudle

Stokes says his department would not have permitted the plan, had it fallen under his jurisdiction. "We would base our judgment on the potential use of the system," Stokes says. "The state just looks at the engineer's plans that say the system holds so many gallons, and that's how many they'll allow. We think there's too much going into that system now, and we believe there may be some risks to shellfish waters there. But it's very hard to prove. We've met numerous times in Raleigh with the powers that be, but our hands are tied."

Richard Koonce, sanitarian in Onslow County, says that developers in his area do occasionally try to use septic tanks to avoid the state's authority over larger treatment plants. But they often do so, he says, because they don't want the red tape of dealing with the state. He confirms that pressure for new buildings is intense in his county, but he points out that his office has turned down hundreds of lots because the soils were inadequate for sewage treatment.

"Wherever you have this rampant development with septic tanks, you're going to find closed shellfish waters" —Stan Taylor

Stan Taylor denies that Environmental Management imposes a burden of red tape on builders. "We've got to approve the request or deny it within ninety days," he says. "The plans and specifications have to be done by an engineer, but the requirements are simple."

Various drafts of legislation aimed at closing The Loophole have come to grief in the state legislature. One of those still kicking is a measure drafted on behalf of local health departments, and was inspired by the problems in coastal counties. The measure, if passed, would put all decisions on subsurface sewage disposal under the jurisdiction of the local health departments.

Environmental Management officials are battling the plan. They say that proposed changes in their own regulations would help close The Loophole. One of the changes would allow the use of innovative new systems employing low-pressure pumps and mounds. The proposals would also relax regulations that now ban the direct discharge of wastewater, even treated wastewater, into shellfish waters. The revision would permit some such discharges, but only if Shellfish Sanitation certified that the discharges did not jeopardize shellfishing. Environmental Management says the revisions demonstrate that the division is making an effort to tailor its rulings to local conditions. But Stan Taylor says the division may actually withdraw some of the proposed revisions, if the health departments manage to get their bill passed.

The Coastal Resources Commission, charged with protecting the environmental health of the coastal region, has also spoken up on The Loophole. The Commission supports the 3,000-gallon threshold, but recommends that developments like condominiums be treated as "design units" and therefore be required to meet the guidelines of Environmental Management. So far, this support has materialized as a letter to the feuding agencies.

The commission recently beat a hasty retreat from its "30-inch separation" rule, which governed the vertical distance between septic systems' drainlines and the seasonal high water table in soils near estuaries. The rule was withdrawn, little over a month after it took effect, when the commission decided it did not have the facts it needed in order to defend it. The rule would have stopped much of the development in places like West Onslow Beach, where the water table is often only about a foot under the surface. According to Liz Lance, the commission's information officer: "We thought it was a good rule, but when it came down to it, we didn't have the hard data we needed to support it."

(A current Sea Grant project by Bobby Carlile, Craig Cogger and Mark Sobsey is designed to help determine vertical and horizontal separation requirements for the state's barrier islands. See page 7.)

But few are betting the commission will stay on the sidelines. Rob Moul, field consultant for the commission at Wrightsville Beach, says his agency is waiting to see if Health Services and Environmental Management can resolve their differences and close The Loophole.

"We're hoping they can find their own solution," Moul says, "one that protects the shellfish waters and water quality of the area. If they don't, I have enough faith in the commission to believe we will step in."

As if the ring weren't crowded enough, the U.S. Environmental Protection Agency is there too, mustering evidence for its environmental impact statement for the state's barrier islands. The agency announced in 1980 that six major sewage plants planned for the state's barrier islands would require the agency's impact statements. All of the six proposed plants, which are integral to their counties' "201" plans, would depend heavily on federal funds. (The plants are planned for Dare, Carteret, Onslow and Brunswick Counties.)

But recently the agency has abandoned the idea of individual impact statements in favor of a single, statewide study grafted onto the agency's barrier islands impact statement, which is keeping various consulting firms busy investigating everything from coastal construction to waterbird populations.

Meanwhile, the treatment plants are waiting, and so are most of the communities, many members of which have long viewed central sewage disposal as the neat way to clean up the septic-tank mess.

One of these plans, which would serve Atlantic Beach and Pine Knoll Shores, carried an $8 million price tag a year ago, a price that doesn't include an expensive ocean outfall for offshore disposal, through submerged pipes, of treated wastewater.

While construction is delayed, large sections of Pine Knoll Shores are being developed with new land-based "cluster systems," and some residents of the area predict the community may now elect not to use the central system, if and when it is built.

Environmentalists have objected to central treatment systems because, they say, they concentrate huge quantities of wastes into a single system that could, if it broke down, produce disastrous levels of contamination. But they also object on the grounds that the systems encourage high-rise resort development, along beaches, with the attendant problems: contaminated rainwater run-off from pavements and buildings, hurricane hazzards, overcrowding, noise and air pollution, and the destruction of natural landscapes and wildlife habitats.

Bob Benton, head of Shellfish Sanitation, also has his doubts about central sewers on the islands. "I think central sewers will increase density," he says. "It may be a self-defeating thing."

In response to such criticisms, the EPA has dictated that 201 plans in areas defined as "areas of environmental concern"—including much of the state's coastline—be only large enough to solve existing problems and allow for 10 percent growth.

Says LaDane Bullington, mayor of Ocean Isle Beach: "We've already grown more than that since the 201 plan was approved last year. Then what do you do?"

Some coastal residents have pointed out, in EPA workshops conducted this spring, that even when and if the new plants are built, they will almost immediately operate at capacity. And then, they say, communities will be right where they started: what do you do about septic tanks?

The agency's consultants are using computers to analyze and map the state's barrier islands, delineating areas suitable and unsuitable for septic tanks and other land-based treatment of sewage. Their report on these "alternatives" is due in September.

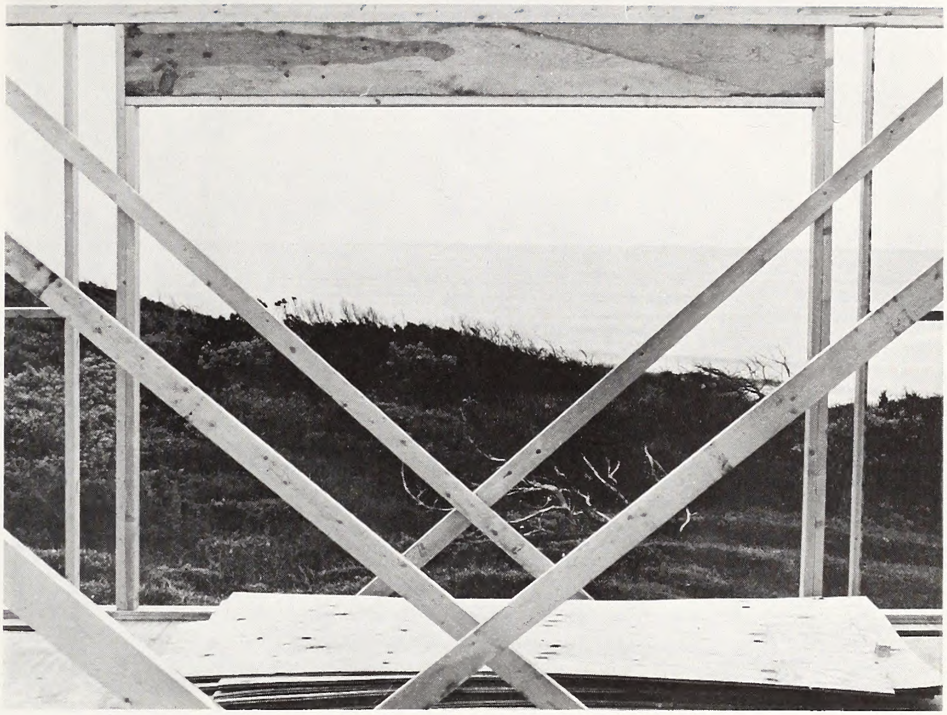
But state officials wonder how the agency can recommend land-based alternatives for the islands, when such issues as vertical separation, density and ground-water contamination are largely unresolved.

"We desperately need to know the carrying capacities for these soils, based on adequate, valid research," says Steve Steinbeck, soil specialist in charge of the septic tank program for Health Services. "Until we have that knowledge, we can't endorse these alternatives."

Bowman Crum, who is directing the preparation of EPA's impact statement from his Atlanta, Georgia office, says he's aware of the quarreling among the state's authorities over The Loophole. But as yet, his study hasn't taken up the problem. "That's something we're going to have to deal with," he says. "As soon as we figure out how."

—Neil Caudle

Photos by Neil Caudle



Framing the seascape

On Bogue Banks, workmen hammer together condominiums for several hundred new residents. Sewage disposal for the complex will be handled by a new "package" system (below), which chemically treats wastes and then releases them into the soil. Several acres of maritime forest were cleared for the drain lines.

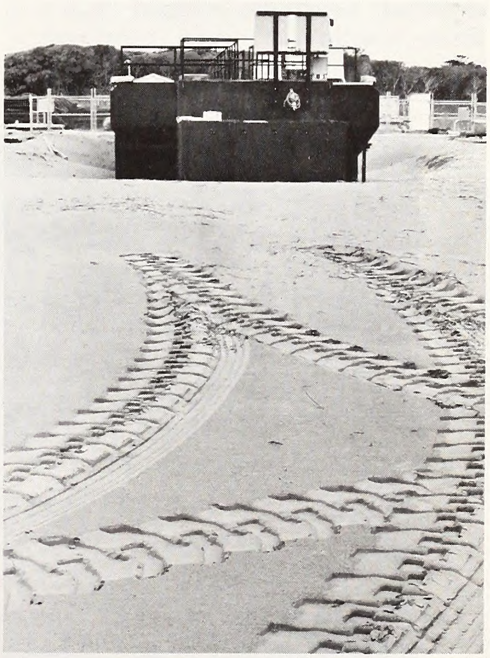
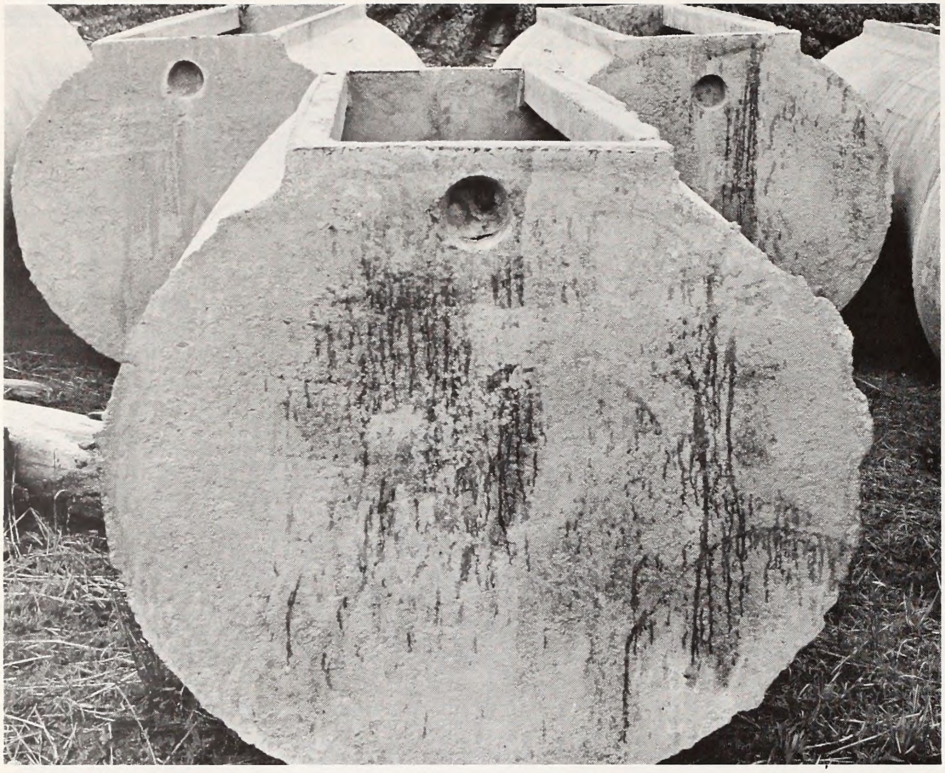


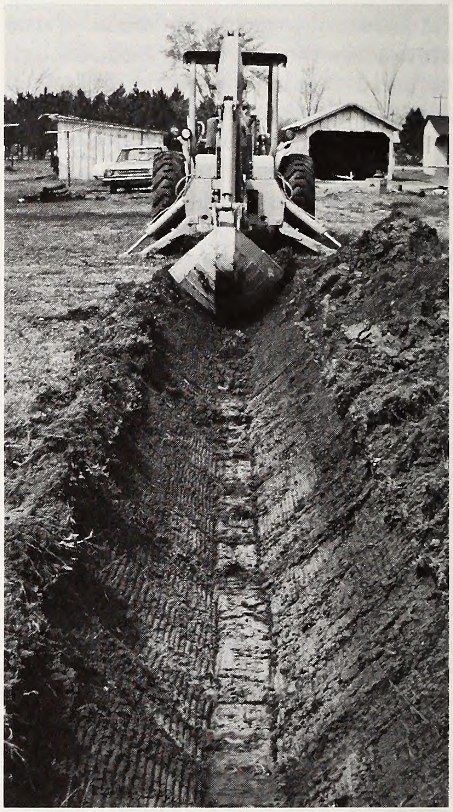
Photo by Neil Caudle

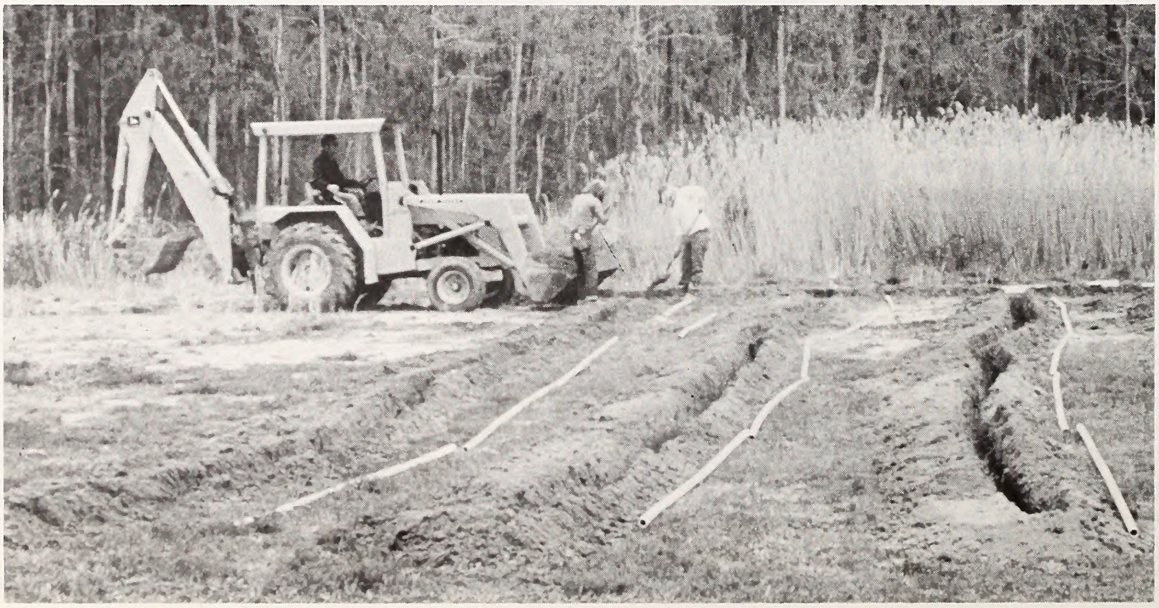


Tools and materials

1000-gallon septic tanks, an efficienct "V-trench" from Carlile and Osborne's design, a low-pressure system being installed, and a joint in the distribution lines.

Photo by Dennis Osborne





Research: beachhead for an underground revolution

There are over two million septic tanks in North Carolina, with some 50,000 new ones each year. Nowhere do they fail with more consequence than along the coast, where half a million residents use them, and where an estimated 70 to 90 percent of the soils are now thought to be unsuitable for conventional, on-site sewage disposal.

Because the stakes were so high, and the alternatives to septic tanks so limited and expensive, Sea Grant began funding research into coastal septic systems in 1977. The research, led by Bobby Carlile of North Carolina State University (NCSU), inspired an underground revolution in on-site sewage disposal. What Carlile discovered was that many of the septic tank's limitations could be overcome if the flow of effluent from the tanks into distribution lines was controlled in even "doses." This he managed with low-pressure pumps, which periodically filled each distribution line, along its entire length, and used the greatest possible area of soil for treatment. For marginal soils, especially dense clays with moderately high water tables, the distribution lines could be laid 12 inches deep. The cost remained low, about $800 for gravel, pipes and pumps (labor was additional).

For very severe cases, on sites with impermeable clays or very high water tables, Carlile built his low-pressure systems into mounds of soils layered to percolate the wastewater safely. Since the mound was essentially a distribution field construction above ground, soils had to be moved to the site, and costs ran into several thousands of dollars.

On test sites along the coast and inland, Carlile built these systems and tested them. Around them he dug sampling wells, where he measured water quality in the surrounding soils. The systems worked; wastewater was contained and treated. On test sites near estuaries, sampling showed that the new systems could operate without raising the level of contaminants in the water.

With the designs thoroughly tested, Carlile and his research associate, Dennis Osborne, took them directly to county health departments, workshops, conferences and training sessions, where the team schooled sanitarians and contractors on how the system worked. Half of the state's coastal counties wrote the new "alternatives" into their sewage-disposal guidelines. New construction valued well into the millions of dollars began on sites once classified as unsuitable for development. But just as importantly, dozens of failing septic systems were replaced with the new designs.

It was something of a renaissance for the lowly septic tank, and demand for Carlile's help began to reach him from the Piedmont, the mountains, and from other states. But the real frontier turned out to be back home, along the state's barrier islands.

There, the antagonists were named Corolla, Leon or Duckston, the wet sandy soils so vastly different from the clays just a short drive inland. On the islands, growth was explosive, and most of it still depended upon septic tanks.

Bob Rubin, an NCSU extension specialist who has often worked with Carlile applying the new designs, says that "about fifteen percent of the land on our barrier islands is suitable for conventional on-site sewage disposal, and much of that is in maritime forest."

Of course, much more than that amount of property is being developed, often with septic tanks. Are they all failing?

"Until relatively recently, most people on the barrier islands did not know they had septic-tank problems," Rubin says. "Those sandy soils are so porous that the effluent doesn't rise to the surface. But it's usually not being treated either. Very often, you can't tell a system's failing, and most people don't try to find out. You know, 'out of sight, out of mind.' "

But many acres of valuable shellfish waters were closing along such places as Atlantic Beach and Surf City, and the blame was laid on septic tanks. Carlile sampled dredge-and-fill sites along finger canals at Atlantic Beach and found coliform bacteria counts 10 times higher on some sections developed with conventional septic tanks than he found on undeveloped

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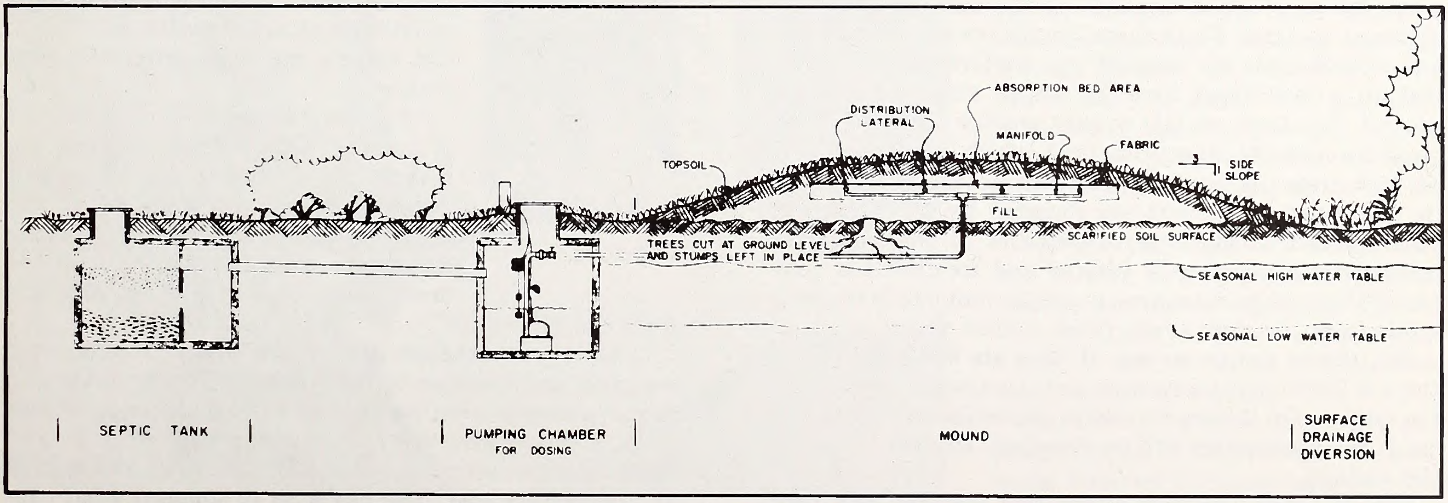
Drawing by Daphne Webster



A mound system, designed for high water tables and poor soils areas. Meanwhile, health officials began to call the risk of contaminated drinking water in some areas "acute."

Agencies began to crack down. New "teeth" in the Ground Absorption Act made permits harder to come by, and applications for new construction were turned down by the hundreds. But there was no hard evidence about either the flow of wastewater from septic tanks into estuaries, or about the contamination of groundwater.

In response, Sea Grant funded another Carlile project, this time geared to the islands. Craig Cogger of NCSU is conducting most of the studies while Carlile is on loan to Texas A & M University. Cogger recently completed research on a project conducted for the N.C. Division of Health Services and funded by the Coastal Plains Regional Commission. The study surveyed 17 sites in coastal North Carolina and found that 16 of the septic systems did not have a minimum 12-inch vertical separation from the seasonal high-water table. Many of the systems, he found, were saturated almost all year, with the effect of releasing raw sewage into groundwater and estuaries. But the study did find that low-pressure systems in the group performed much better than conventional ones in marginal soils, although they also performed poorly on sites saturated most of the year.

Bobby Carlile with mound system

For his Sea Grant project, Cogger is setting up test sites at West Onslow Beach. There, he will operate model septic systems, including conventional septic tanks and the low-pressure alternatives. Using various loading rates, dosings and separation distances, Cogger will study each combination for the movement of effluent through the soil.

Cogger will also use "tracer" compounds to monitor the flow of wastewater horizontally through water-saturated ground. The studies are designed, he says, to show just how far contaminants travel in each direction, and how complete is the treat-

Sticking up for the lowly septic tank

The very words have a malodorous, subterranean tone: septic tanks. But are they really so villainous as their reputations?

Dennis Osborne, a Sea Grant researcher and member of the NCSU Soil Science Department, says no, they aren't.

"The ones that work, work beautifully," Osborne says. "It's the best, low-cost, natural treatment system there is."

Osborne says that in conventional septic systems, working properly, things happen this way: Waste collects in the septic tank, where it decomposes through the anaerobic action of bacteria. From there, liquids containing nitrogen and phosphorous are released into perforated drain lines, laid in gravel-lined trenches about three feet under ground. The lines are laid so that gravity disperses the liquids through the absorption field, which is usually planted with grass. As liquid passes through the soil, some of its suspended substances are digested by microbes, and others attach themselves to particles of soil, until the wastewater is thoroughly filtered and treatment is complete. The only maintenance normally required is to pump solids from the tank every three or four years.

But things can go wrong. If lines are laid in wet soils, there is little or no treatment, and raw sewage seeps out of the system. Or, if lines are laid in impervious clay, very little of the wastewater will be absorbed. Instead it rises to the surface.

Osborne says the new alternative systams he's been working with overcome some of these limitations by dosing the soil under pressure. The controlled dosing means that drain pipes can be installed in trenches as shallow as 12 inches, well within the "dry" range of many coastal soils. Also, the shallow lines can be snaked into wooded areas, avoiding the need to clear-cut trees.

But Osborne cautions that these new systems require maintenance, and that they can be misused. "We require a back-up pump on the systems we install, and an alarm to warn you of a breakdown," he says. Distribution of the effluent must be checked in standpipes attached to the lines. And, the system must be protected from grease.

Osborne

"Fast-food restaurants produce a lot of grease," Osborne says. "They use water at a hundred-and-eighty degrees, and at that temperature, the grease is emulsified. It just bypasses the grease trap and winds up in the lines, where it sort of coagulates and seals everything up."

Osborne nevertheless prefers, for many sites, a well-designed septic system to the "package" treatment plants that chemically treat wastes and serve multiple buildings.

"The cluster systems, I've seen work fine, when they're designed adequately," he says. "But they can also impose an unnecessary cost. You pay a lot to simulate what happens naturally in the soil."

ment along the way.

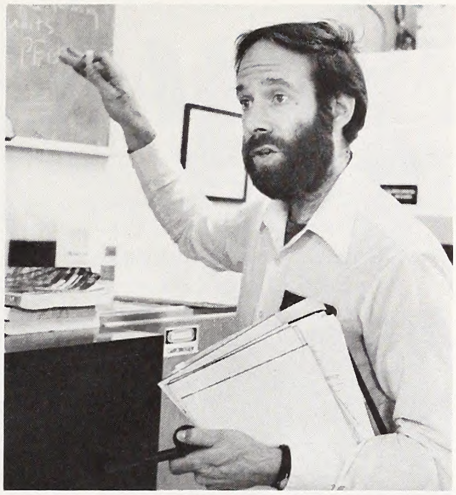
Mark Sobsey of the University of North Carolina at Chapel Hill, an associate on the project, will track the microbiological pathogens in the effluent flow and compile water-quality data for the sites. In another Sea Grant study, Sobsey has already upset some long-held notions about "safe" water. Sobsey found that the coliform bacteria long thought to be reliable signals of contaminated water are not completely reliable. Current standards for water quality, he found, do not accurately indicate the presence of or absence of enteric viruses, the tiny pathogens, often carried by sewage, that infect people with viral hepatitis and viral gastroenteritis.

Cogger believes the results of the study will supply officials with facts they can apply to several of their most critical problems: How much vertical separation should be required from drain lines to water tables? How far must systems be set back from estuaries in order to protect fishing there? How well do the low-pressure alternatives work in the sandy soils of barrier islands? And, how much effluent flow, or density, can these soils take before the effluent overcomes their capacity to treat it?

"We suspect that the twelve-hundred-gallon number (Environmental Management's density guidelines) errs on the side of allowing too much density, if anything," Cogger says. "But we just won't know for sure until we have the data."

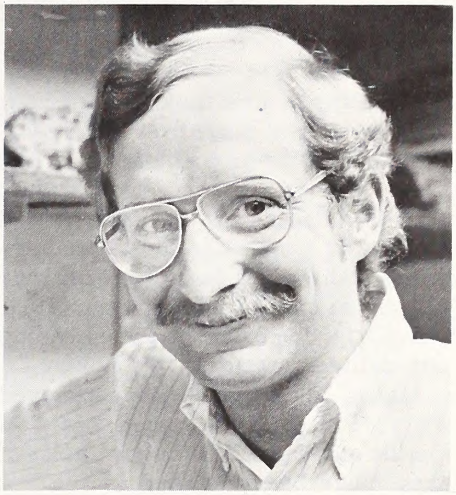
—*Neil Caudle*

Photo by Neil Caudle



Mark Sobsey

Photo by Cassie Griffin



Craig Cogger

Bob Rubin, Al Harris and Joe Rose with blueprints

Craven County: A green light

Five men are huddling together in the rain to dig a hole in the sandy, side lot of an abandoned store near New Bern. One of them lets a fistful of damp soil slide through his fingers to test its composition.

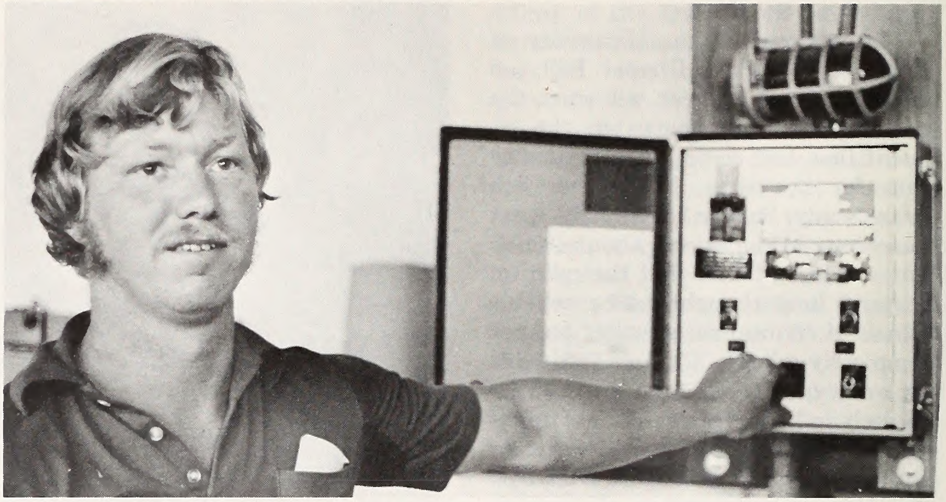
In Craven County, or most anywhere else, this is where new construction begins. Here, Joe Rose, a New Bern engineer, is trying to get a permit for his client, who wants to renovate the empty building and open a large grocery. But there are complications. The grocer will use much more water than the previous tenant; there is no public sewer to the site; space is limited, and the soil is not the best.

"A few years ago, we would have had to turn this man down," says Al Harris, sanitarian supervisor for the Craven County Health Department. "The soil here is not, as it is, suitable for this kind of volume."

But Harris says that innovative new designs in on-site septic systems have made building on marginal sites prac-

Continued on next page

Photo by Neil Caudle



Jerry Somers, with alarm and timer

tical. For Joe Rose and his client, that means a low-pressure mound system and a green light for the grocery.

"The first septic tank was made in France in the seventeen-hundreds," Harris says, "and nothing much had been done to improve it until just recently. Because of the interest Sea Grant and North Carolina State have taken in these new designs, we can give people a quality installation. If it weren't for them, we'd still be handing out eighteenth century technology."

Harris' department has approved about 75 alternative systems, based on Carlile and Osborne's designs. Most of these have been installed in the last two years, many for businesses. Harris tells the story of a textiles firm that wanted to build near Vanceboro. It promised 80 badly needed jobs. But the soils on its building site were poor. Carlile, Osborne and Bob Rubin designed the low-pressure mound system for the plant, and specified water-stingy plumbing fixtures.

"No problems at all," says the plant's mechanic, Jerry Somers, of the system. "We just check it once in a while and keep the grass mowed."

Harris says the alternative systems have helped his county substantially broaden its tax base, while easing some health and environmental risks. But using the new systems, he says, incurs some stiff responsibility, not only for his department, but for the property owner.

"We've had to become educated in these designs," Harris says. "And they require some management. We are establishing a checklist for alternative systems, and we'll conduct regular inspections."

The checklist includes the alarm system, the levels in riser pipes, the sequence of the pumps and the condition of the grass over the absorption field.

"They've done a good job using this technology in Craven County," says Bob Rubin of Harris' department."They've got a qualified staff and they're not afraid to learn new things and examine the alternatives."

Such close supervision of the new installations, Rubin says, is crucial to ensure the technology is not misused. "These things are not a panacea for every sewage-disposal problem," Rubin says.

Osborne and Craig Cogger say that there are already cases of mounds that have been installed improperly. Some of these have failed. One of the most notorious examples is the mound system for a fast-food restaurant in Shallotte. The mound was built by a private firm, and did not provide adequately for the huge quantities of grease the restaurant produces.

Bob Benton says the shoreline surveys his staff at Shellfish Sanitation has conducted have also found mounds failing.

Cogger and Osborne say these failures are due to inadequate maintenance and design. But not every county health department, they say, is as well-versed in the new alternatives as the one in Craven County.

"You have to have some kind of management framework to handle these problems," Cogger says. "And you need education and extension for the health departments; they really need the support of trained experts."

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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To help us specialize our services, please answer these questions.

I am in the following line of work:

___Boatbuilding/Repair

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___Marine operator

___Marine recreation

___Mass media

___Seafood processing/marketing

___State government

___University professor/researcher

___Other ____________________

Coastal property owner ___yes ___no   Boat owner ___yes ___no

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).

North Carolina eel fishermen are upset. In 1979 and 1980, eels were bringing fishermen $1.00 to $1.25 per pound and, with these prices, more fishermen began cashing in on the eel fishery. But this year, early spring prices began around 90 cents per pound and rapidly plummeted to 45 and 50 cents per pound. Now, most dealers aren't even buying eels.

Fishermen wanted to know what happened to the market, so two Sea Grant Marine Advisory Services agents got on the telephone to find out. Bob Hines and John Foster contacted East Coast eel buyers and fisheries export officials in the U.S. Department of Commerce. They found that the reasons for the price drop appear to include a glut of small eels in the European market, a decline in demand caused by PCB-contaminated eels appearing in Europe, red sore disease showing up in North Carolina eels, a shift in the monetary exchange rate, and an unreasonably high price paid to fishermen in the two previous years.

"There is still a market for large eels over three-quarters of a pound," Hines says. "But the fishermen are not catching enough of those large ones to justify fishing." Hines says the larger eels may have moved further inland, out of coastal fishing waters, due to unusually high salt content in the water this year. He also says that there might be too many fishermen in the business.

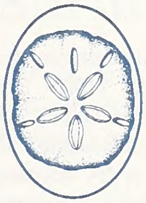
Foster and Hines say the future price is expected to stabilize at a lower level. Prices are expected to range between $.50 and $.75 per pound, depending upon supply and demand, for at least the rest of 1981.

Sea Grant became active in the development of the North Carolina eel fishery in 1973, when most of the eel harvest was used locally for bait. Since then, the fishery has grown rapidly on the strength of exports to Europe and Japan. Landings in the 950,000-pound range were reported in both 1979 and 1980, according to the N.C. Division of Marine Fisheries. The 1980 harvest brought a record value of $1 million.

Sea Grant is still active in developing the fishery and ready to answer questions for and offer advice to eel fishermen. For names of eel buyers or suggestions for holding eels, contact Bob Hines at the N.C. Marine Resources Center/Bogue Banks, P.O. Box 896, Atlantic Beach, N.C. 28512, or call (919) 726-0125. For information on eel aquaculture, contact John Foster at the NCSU Aquaculture Demonstration Project, Route 2, Box 305, Aurora, N.C. 27806, or call (919) 322-4054.

It may be water, water everywhere along coastal North Carolina, but the problem comes in how to manage North Carolina's sounds, rivers and estuaries. Fishermen want to fish from them, farmers want to drain their fields into them, industry wants to draw from them. It seems everyone has a use for North Carolina's coastal waters, and management is a big job.

That's why a task force has been gathered by the Department of Natural Resources and Community Development to study the problems of water management on the peninsula between Albemarle Sound and Pamlico Sound. Joe Phillips of the NCSU Soil Science Department will chair the group. B. J. Copeland, UNC Sea Grant's director, is also on the task force. The group will combine the views of scientists, management officials and water users like fishermen, farmers, foresters and industry representatives as they try to reconcile differences and optimize the uses of coastal waters.



Director of UNC Sea Grant's Marine Advisory Services, J.C. Jones, has announced his retirement from North Carolina State University, effective June 30. Jones is subsequently stepping down from his Sea Grant post. Jones has directed advisory services programs since July, 1979, and has been instrumental in coordinating the work of Sea Grant with the extension and education programs of the N.C. Agricultural Extension Service and the three N.C. Marine Resources Centers.

Jones will remain director of the Department of Administration's Office of Marine Affairs.

Randy Rouse has joined John Foster and Roberta Kincheloe at the NCSU Aquaculture Demonstration Project in Aurora. Rouse will be working with Foster and Kincheloe to develop and perfect culturing methods for the American eel.

Each year, several fishermen who trawl or dredge in North Carolina's offshore fishing grounds bring up an unexpected harvest—explosive ordnance. As a result of military training, sea dumps and combat operations, both explosive and nonexplosive ordnance can be found along the eastern U.S. continental shelf. Sea Grant has a new publication out to aid fishermen with bottom-tending gear in the identifica-

Continued on next page

tion and disposal of these unwanted harvests.

A Fisherman's Guide to Explosive Ordnance has been prepared in cooperation with the U.S. Naval Explosive Ordnance Disposal Technology Center. Included in this booklet are photographs and illustrations of the more common types of ordnance occurring off our coast. Fishermen are also given instructions for safe disposal of ordnance recovered in nets or dredges.

A copy of this booklet is available free to any interested fishermen. Write Sea Grant, Box 5001, Raleigh, N.C. 27650 and ask for UNC-SG-81-05.

Two new Sea Grant publications on aquaculture have arrived from the printers. *A Discussion of Aquaculture Candidate Species for Eastern North Carolina,* by former UNC Sea Grant associate director William L. Rickards, evaluates the feasibility for commercially culturing various species of finfish and crustaceans in the fresh and brackish waters of eastern North Carolina. For a copy of this publication, send 50 cents to UNC Sea Grant. Ask for publication, UNC-SG-WP-81-2.

Teaching Young American Eels to Consume Prepared Feeds, by John E. Foster and William L. Rickards, is a discussion of methods used by the NCSU Aquaculture Demonstration Project for teaching elvers or baby eels to feed on commercially prepared feeds. For a copy of this publication, send 50 cents to UNC Sea Grant. Ask for publication, UNC-SG-WP-81-3.

Sea Grant in North Carolina, 1979-1980, by Neil Caudle, is a report on two years of Sea Grant research, education and advisory services activities. For a free copy of the 31-page report, write UNC Sea Grant.

Long exposures to the sun can cause skin cancer. Jim Patterson, a dermatologist at the University of North Carolina, says a lot of the patients he treats for skin cancer and sun-related skin damage are farmers and fishermen who spend long hours under the sun's rays, away from shelter. Fishermen may be even more susceptible, he says, since they get double doses of sun from rays bouncing off the water.

North Carolina fishermen have an added problem because many of them are fair-skinned. Much of coastal North Carolina has a western European heritage and their skin doesn't take the sun well, Patterson says. "They burn, freckle and generally don't tan well," he says.

To learn more about the problems fishermen have with the sun, write for UNC Sea Grant's latest Blueprint, "Fishermen and Skin Cancer." To receive this free leaflet, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650. Ask for publication number UNC-SG-BP-81-6.

North Carolina's seafood industry is one subject student Michael A. Blake has added to his curriculum. Blake, an economics major at North Carolina A&T State University, has been awarded a Sea Grant Fellowship to work with researchers, Nozar Hashemzadeh and Michael Simmons, from the university's economics department.

A native of the Virgin Islands, Blake will be compiling information gathered from the state's fishermen, seafood processors and marketers. The goal of Hashemzadeh and Simmons' project is to determine the manpower needs of the seafood industry. The information will help in the development of training programs for skilled and technical workers. The team is also devising a model which will help predict future manpower demands of the seafood industry.

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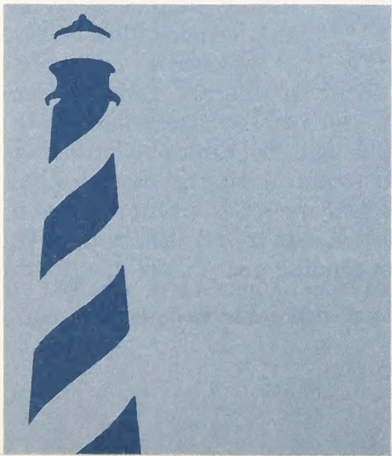

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COASTWATCH

Photo by Mark Hooper

''For Robert'' is a photograph by Mark Hooper, a Carteret County shrimper. The photograph is dedicated to Robert Willis, Hooper's neighbor, who heads shrimp for Hooper each morning during shrimping season. The photograph won first place in black and white prints, best in show, and the N.C. Marine Resources Center Purchase Award in the 5th Annual Bogue Banks Nature Photography Competition and Exhibit

Shrimp

Talk of shrimp gets thick in coastal North Carolina about the beginning of June. Shrimpers speculate about the coming season, always hoping it will be better than the last. Biologists and managers at the North Carolina Division of Marine Fisheries work day and night to check shrimp nursery areas. Seafood dealers and marketers begin checking prices and supplies of shrimp in other states.

Shrimp are the most valuable seafood crop North Carolina waters offer. Last year, 9,823,000 pounds of shrimp, valued at $17 million, were landed in the state. But last year's nettings were a record catch. North Carolina shrimpers hadn't seen such large quantities of shrimp in over 25 years. The average catch for the past 25 years stands at just over six million pounds a year.

Three species of shrimp are netted in North Carolina—pink, white and brown. Brown shrimp are the most numerous. Shrimpers trawl for ''browns'' July through September. Pink and white shrimp are less abundant. They are netted in the fall.

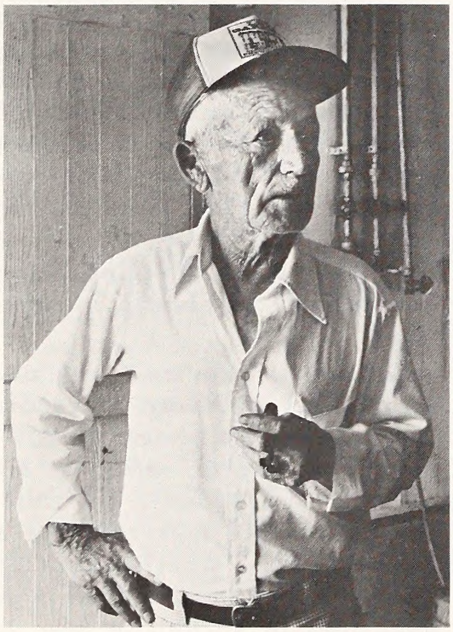
This month and next, Coastwatch will look at the shrimp fishery in North Carolina—the story of its shaky beginnings, the people who study and manage it, the people who depend on it for their living.

The delicacy they used to call 'pests'

A large sign on a roadway in Carteret County reads: SHRIMP $3.25/LB. Many a shrimp lover turns out his pockets for a handful or so of those spiny crustaceans. But not long ago, 60 years or so, a fisherman could hardly give shrimp away in coastal North Carolina. Shrimp were considered "pests" that littered fishermen's nets.

Luther Lewis, a 70-odd-year-old Carteret County fisherman, remembers when nobody wanted shrimp at all. "There was nobody catching 'em then. Nobody wanted 'em," he says. "You could take the rigs they have now and load a boat in a few minutes.

Photo by Cassie Griffin



Luther Lewis

"I went long-hauling when I was a kid," Lewis says in a low, raspy voice. "We'd see a big school of bluefish out in the sound, all right thick. But one day I had something on the boat to throw in, to the gulls. And the gulls went in after it and came up hauling these big shrimp. It wasn't a thing in the world but those big shrimp going through the sound."

The findings of two Sea Grant researchers, East Carolina University sociologists John Maiolo and John Bort are proving Lewis' recollections right. With historian William Still, Maiolo and Bort have compiled a history of the North Carolina shrimp fishery. The study is designed to give state management officials an understanding of a fishery colored by tradition.

The shrimp fishery got a slow start in North Carolina. Inadequate refrigeration facilities and poor transportation methods were devastating obstacles for a fishery depending on such a perishable product as shrimp. And, fishermen had obstacles of their own. Boats were small and gear was simple—gill, cast, dip, fyke and pound nets were used.

The shrimp fishery had its beginnings in North Carolina's southeastern counties—Brunswick and New Hanover. Maiolo and Bort learned from R. E. Earll's 1887 account of the North Carolina fisheries that Wilmington was the "most northern city on our Atlantic coast where the shrimp fishery assumes the importance of an actual industry." Earll also reported that shrimp were plentiful north of Wilmington in the Pamlico Sound, but there was no local interest in the crustaceans or any interest in exporting them out of the area.

But two developments in the shrimp fishery prior to World War I gave the North Carolina fishery a needed boost, Maiolo and Bort found. Several shrimp canneries were established about 1915 in Brunswick County. This created the first need for large quantities of fresh shrimp in this state.

But perhaps more important to the shrimp fishery nationally was the development of the otter trawl. An otter trawl is a cone-shaped net held open by two boards called otter doors. The otter trawl allowed fishermen to fish deeper water and offshore areas for the first time. It netted a greater catch and was more efficient to use. With the development of the otter trawl came a change in boat design. The first "trawlers" were much like the boat Lewis shrimped from in the waters of Core Sound.

"I started shrimping in a small skiff with a little gasoline motor," Lewis says. "It was a thirty-footer and I drug a thirty-two-foot trawl net with two doors. I had my first big trawler built in the mid-thirties. I had it made by a man here in Davis, Stanton Davis I believe. It was a single rig."

By the thirties, two types of trawlers were used to shrimp in North Carolina. The Florida trawler, developed in the state that bears its name, carries the engine room toward the front of the boat and the hold in the stern. It stands high out of the water, with the bow two or more feet higher than the stern. The "Core Sounder," built in the Core Sound area of North Carolina, has a flared bow and rounded stern. It works particularly well for trawling inside waters.

The otter trawl revolutionized shrimp fishing and after World War I, the fishery prospered, both nationally and in North Carolina. Refrigeration and North Carolina's easy access to the Fulton Fish Market in New York benefited this state's fishery, Maiolo says. Brunswick County, and in particular the Southport area, led the state in shrimp landings most of the 1920s and 1930s.

Southport's population mushroomed during shrimp season as migrant fishermen arrived to net their share of the crop. Most of the shrimping in those days was carried out during the day. Boats would pull out of their docks early in the morning and return during the afternoon. Then the fun came, according to Southport's *State Port Pilot*. Several hundred "pickers" headed the shrimp, sometimes long into the night, singing as they worked. You could hear "a real melody floating up from the picking houses," the *Pilot* reported. The pickers were paid a nickel a bucket for their efforts.

But Brunswick County's near monopoly of the shrimp industry ended during the 1930s as Carteret County fishermen took to shrimping the Bogue, Core and Pamlico Sounds. It was a poor time though for fishermen to cash in on shrimp, Maiolo and Bort report. During the depression years of the 1930s shrimp were bringing only about three cents a pound. To help fishermen help themselves during these bleak years, the federal government loaned fishermen, who wanted to join, the money to gear up a cooperative that would pay higher prices for their catches. But competition from independent dealers and the inability to establish an in-state market led to a quick demise for the cooperative.

During the years of World War II, manpower shortages presented problems for the shrimping industry, but the war had several positive advan-

Travel and Tourism photograph

In this 1948 photograph, single-rig trawlers head toward Southport

tages for the fishery. Demand for shrimp rose as it was one of the few meat products not on the ration lists. The technology for quick freezing was established and shrimpers began to "night" shrimp.

Prices shrimpers were paid for their shrimp nearly tripled between 1940 and 1945, Maiolo and Bort report, and did triple between 1945 and 1950. Even then, fishermen were getting paid only 24 cents a pound and prices would fall again before beginning the steady increase of the 1960s and 1970s.

"The year of (Hurricane) Ione, right after (Hurricane) Hazel washed my shrimp house away," Luther Lewis says, "I was getting fifteen cents a pound with the heads on and eighteen cents with the heads off. We headed 'em right on the bank. Sometimes we'd get fifteen hundred to eighteen hundred pounds for the night. That was several boats, then. That was mighty cheap when you were paid only eighteen cents a pound with the heads off."

North Carolina's shrimp production reached a record high in 1953 with landings totaling more than 14 million pounds. That year, North Carolina's contribution to the South Atlantic regional catch (excluding the Gulf) was 36.48 percent, the highest ever, according to Maiolo and Bort's findings. Biologists are unsure exactly why shrimp were so plentiful that year.

During the 1950s a trend toward larger boats began and it continues today. Many trawlers were equipped with diesel engines, onboard refrigeration facilities, better net-hoisting gear and improved nets. Trawlers were capable of going farther offshore and making longer trips.

In 1955, Maiolo and Bort report, 2,000 North Carolina residents were employed in the shrimp industry. Some 1,200 vessels of all sizes and types were being fished. Between 1945 and 1950, the number of otter trawls doubled from 500 to more than a thousand. Since 1950, the number of otter trawls has remained between 800 and 1,000.

While the state's shrimp industry developed, so did the state's management system. The state Board of Conservation and Development made early shrimp regulations. Before the shrimping "heydays" of the late forties and early fifties, very little challenge was mounted to their regulatory practices. But after the shrimping boom, demands were heavier and controversy rampant. In the late 1940s, a controversy erupted between fin-fishermen and shrimpers. Fin-fishermen maintained that shrimping was destroying valuable bottom area and killing premarketable finfish. They wanted shrimping curtailed, Maiolo says. In 1950 the Board, as a compromise move, closed inside waters to shrimping January 1 to July 1. But the controversy's flames ignited again when, in 1951, the Board agreed to allow "night" shrimping.

While fishermen and management officials were battling over regulations in public hearings, some Carteret County fishermen were establishing some informal, but rigid rules for another kind of shrimping—channel-netting. Carteret County fishermen developed this method of shrimping in the late 1930s. It was thought that channel-netting was unique to North Carolina, but recent research has uncovered evidence that some Texans also channel-netted. It appears the developments were independent.

Channel-netting is basically stationary trawling. A net, very similar to a trawl net, is set in a channel with a strong tidal current. The ebb tide moves the shrimp into the net. Only a limited number of areas are prime spots for channel netting. Consequently, informal but firm rules have been established by the netters to govern the areas and use of the nets.

In their best hauls, channel nets have harvested over a thousand pounds of shrimp on one ebb tide. But normally a channel-netter expects much less, 50 to several hundred pounds. Channel netting contributes very little to the overall state shrimp landings, but it continues to survive as a tradition and as a low cost, energy-efficient form of shrimping.

The last major development in the shrimp industry occurred, Maiolo and Bort report, in 1955 with the development of the double rig. It allowed trawlers to net even larger quantities of shrimp. Since then, other improvements in gear have continued—nylon nets, automatic pilot and loran navigation systems.

When Luther Lewis was a child, the idea of a winged trawler fishing the sounds and offshore waters for shrimp would have received scoffs and jeers. But those trawlers are a reality, netting thousands of pounds of shrimp just 60 years after Luther Lewis watched gulls pick shrimp out of Core Sound.

—*Kathy Hart*

Managing fish and fishermen

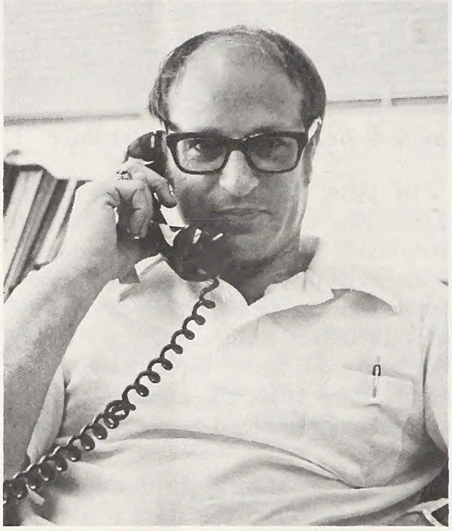
When it comes to managing a commodity as precious as shrimp, everyone has an opinion. "That creek off Core Sound should be opened to shrimping," laments one fishermen. "It should stay closed," says another. The season should be shortened, gear restricted, areas opened, areas closed—all complaints and opinions funneled into a building in Morehead City that houses the managers, the North Carolina Division of Marine Fisheries (DMF).

Mike Street, part of the fisheries management team, says they hear it all—good and bad. "Our philosophy for management of the shrimp fishery is to get the best yield, biologically, economically and socially, from the crop available," Street says. "That's the only way everyone can benefit."

For the DMF, shrimp is the most valuable seafood crop they manage. They spend countless hours and thousands of state dollars to do the job. They intensely sample the primary nursery grounds in May and June for numbers of brown shrimp present and for environmental factors like salinity and temperature that will affect the shrimp's survival rate. For division biologist, Dennis Spitsbergen, 12-hour days are common as the shrimp crop begins to ripen. He may spend eight to 10 hours aboard a DMF trawler sampling some remote nursery area, then another four hours in Morehead City headquarters computing figures and meeting with other management officials to advise them on current situations.

"North Carolina's fisheries management system is unique," Street says. "It's a very active, responsive system." The state legislature delegates all authority for making regulations to the state fisheries commission, which meets at least four times a year. But for a fishery such as the shrimp fishery, where conditions vary quickly, Connell Purvis, the division's director, can issue regulations via proclamation. For the shrimp fishery, most of the proclamations announce openings and closings of secondary nursery areas where shrimp have reached a marketable size. (Primary nursery areas are never opened to shrimping.) Proclamations are posted by DMF enforcement officers and can take effect as soon as 48 hours later. Usually, Street says, the division tries to give fishermen more notice.

Photo by Kathy Hart



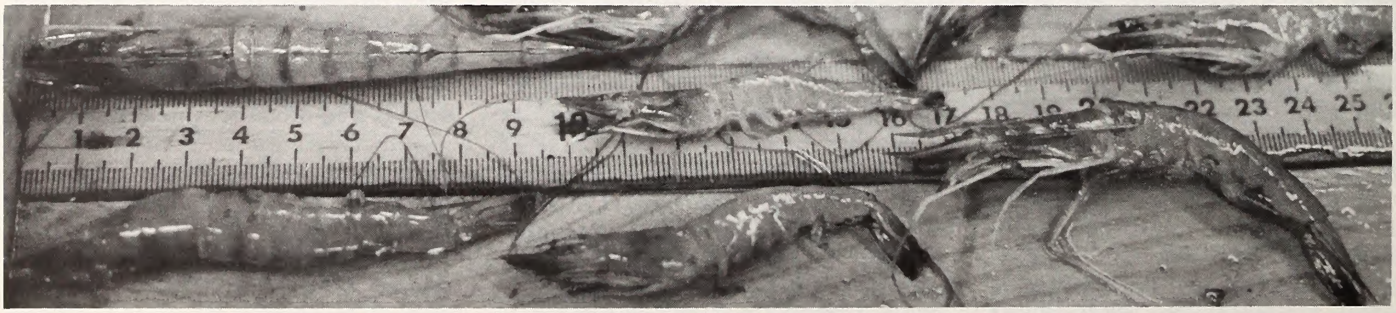
Mike Street

Under North Carolina's management system, shrimpers can fish offshore and inside waters—bays and sounds—year round. These are areas Marine Fisheries call "migration routes" or paths by which shrimp exit the nursery areas for their offshore spawning grounds. Fishermen fish these migration routes as the shrimp begin trickling out of the shallow nursery areas.

Street admits that under this system daily catches may be lower, but he says, the overall catch for everyone will be greater. He points to last year's record catch (the largest in over 25 years) as evidence the plan works. "The same drought we had last year, that helped us, resulted in good crops in South Carolina and Georgia," Street says. "But their management is quite different from ours. Their management is for the big boats. Very few of their inside waters are open for shrimping. So their boats stayed out in the ocean waiting for the shrimp to come out. Waiting and waiting and waiting. It stayed dry and they didn't come out until late in the year and then all at once. They couldn't get them all. Their landings were low. I think our approach to management was justified by conditions last year."

Besides preventing the problems Street says plagued Georgia and South Carolina, the present management system also put an end to the traditional "opening day" for shrimping. Prior to the 1970s, shrimp season opened every year around July 1. Fishermen and fisheries personnel alike say every shrimper in North Carolina had his boat in the water that first day. "You could see as many as 500 boats in New River on opening day," Street says. "You could fly over almost any bay in the state and it would look like one big mud roll. Then there would be a huge fish kill several days later. They were catching some areas out in that one day, not to mention that they were physically disturbing bottom areas. The system we have now allows for better utilization of the fishery and a calmer situation. It's better for the environment, and no place

Photo by Kathy Hart



DMF samplers check the sizes of shrimp just brought from a sampling area

> *"Our philosophy for management of the shrimp fishery is to get the best yield, biologically, economically and socially, from the crop available."* *—Mike Street*

is emptied in a single day of fishing."

The year-round season also allows fishermen to cash in on the pink shrimp that overwinter in the state's sounds and bays. If the winter temperatures aren't too cold, a sizable crop of pink shrimp will emerge from the mud when the temperatures turn warm. Shrimpers can net the "pinks" and some extra income in May and early June while they're waiting on the "browns" to grow fat in their nursery.

Managing for the good of all also means managing areas differently. Street says there is no single overall count range (count is the number of shrimp per pound) for the state's coastal waters. Each area is managed separately according to its capabilities. The DMF doesn't open all its secondary nursery areas when the shrimp in Pamlico Sound reach 45 count. Instead they sample in all areas and open creeks and bays when the count is right for that area's normal production. Street says the DMF expects 41- to 45-count shrimp from the Pamlico Sound in early summer and 20- to 25-count shrimp in the fall, sometimes larger. Normal production for the New River is 60-count shrimp, while Brunswick shrimping grounds produce 70- to 80-count shrimp.

Besides predicting the count sizes of shrimp from various coastal waters, the DMF also predicts each year's expected yield of shrimp for the state. The prediction is based on sampling that begins in early May. DMF trawlers are sent to the nursery areas where they take short samples and calculate the catch per minute. "If the catch is hundreds of the one- to three-inch shrimp per minute it will be a good year," Street says. "In a bad year, we may only see ten, fifteen, twenty a minute. Of course there is tremendous variability among different areas. For one nursery 30 per minute may mean a good year, for another area it's practically no shrimp at all."

Street says this year's crop is running later than usual. DMF samples show smaller shrimp in fewer numbers than last year. A late cold snap in early May that dropped water temperatures below 68° F may have damaged this year's crop, Street says.

Some fishermen grumble that the DMF shrimp prediction affects the prices they receive from seafood dealers. But Street says the prediction can help fishermen decide whether to rig out for shrimping. Street and others say the price of fuel is causing many fishermen to think twice about trawling for long hours unless they are certain of a "netted" return—shrimp.

Management officials feel maintaining the nursery areas is vital to the fishery. In the mid-1970s the division closed primary nursery grounds to shrimping to keep fishermen from netting the small, yet unmarketable shrimp and to protect the natural habitat shrimp need to nurture. But Spitsbergen and Street stress that protecting the nursery grounds from fishing isn't enough. Freshwater intrusion from agriculture and industrial development is lowering the salinity in some nursery areas, thus destroying the habitat the shrimp need to survive.

Street says that while rising costs—especially for fuel—may someday make shrimping prohibitive for some fishermen, the fishery cannot be overfished. He explains that shrimp are an annual crop. They are born and they die in a year's span. The survivors of this year's crop—those not netted by fishermen or killed by natural causes—return to the ocean to spawn next year's shrimp. "Trillions of tiny larvae are spawned annually and ninety-nine percent die naturally," Street says. "As long as the shrimp can spawn in reasonably clean waters, come through a sound that is reasonably clean to a nursery areas to grow that has the environmental conditions they need, there will be shrimp."

—Kathy Hart

Fishermen on management

At the request of the Division of Marine Fisheries, Maiolo and Bort asked fishermen about the agency's management efforts. They surveyed 97 full-time commercial shrimpers and 78 part-time commercial shrimpers. Maiolo and Bort asked the fishermen how they would evaluate the assistance provided themselves and other fishermen by DMF personnel. "The results are surprisingly favorable, given the fact that such agencies are usually the target for everything that goes wrong," Maiolo says.

	all fishermen	full-timers	part-timers
poor rating	25%	51%	13%
satisfactory rating	36%	29%	39%
high rating	39%	20%	48%

Maiolo says most of the fishermen who gave DMF a poor rating did so because they felt the agency was not helpful. But when asked about specific DMF policies, most of the shrimpers gave the agency a favorable nod.

	% full-timers approving	% part-timers approving
geographical restrictions on shrimping	82%	78%
restricted seasons for shrimp	63%	85%
restricted gear for shrimp	72%	74%

Better policies Rely on research

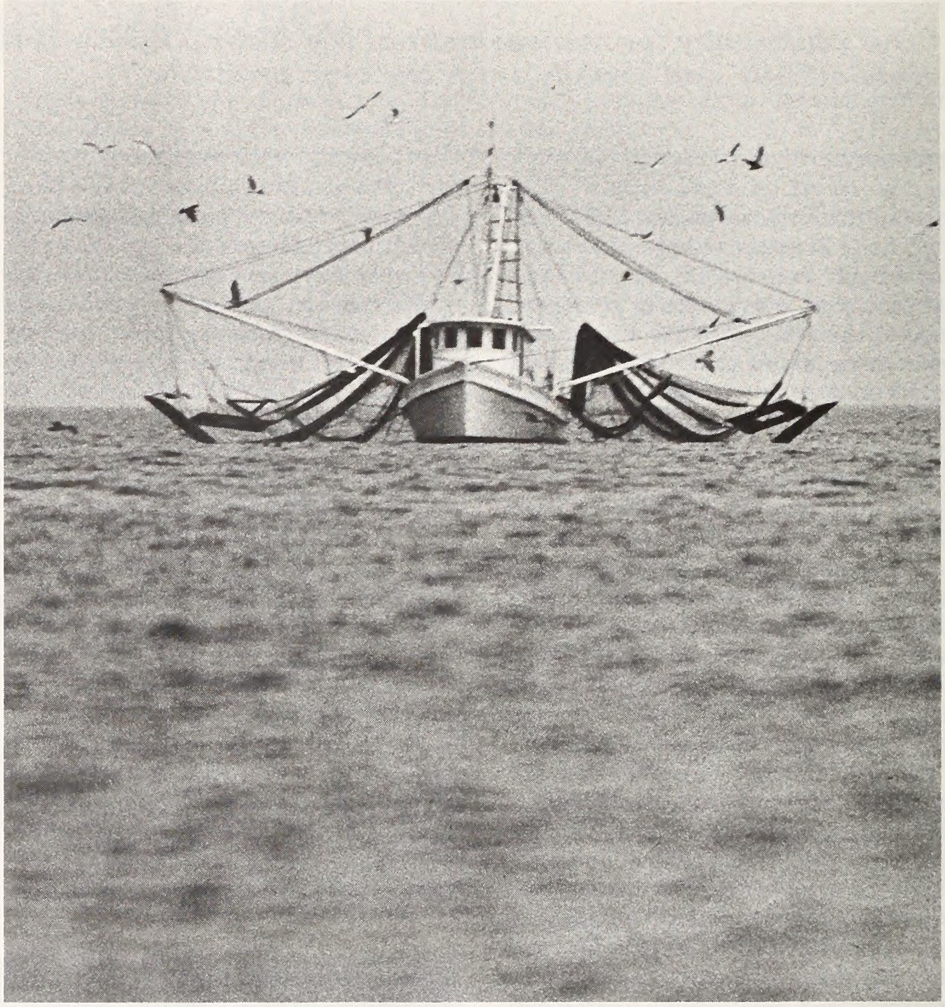
Managing the shrimp fishery is complicated, and demands good information. And that's where UNC Sea Grant projects can help management agencies like DMF.

During 1979 and 1980, George Fishman, a researcher in the Curriculum in Operations Research and Systems Analysis at the University of North Carolina at Chapel Hill, developed a computer model that will evaluate alternative management policies for the shrimp fishery. Plugged into the model are the biological features of shrimp such as migration habits, mortality rates, distribution in the estuaries, length-weight relationships. The model also takes into account characteristics of the shrimp fishery—number of fishermen shrimping, the intensity of their shrimping efforts. Finally the model figures in the price structure of the fishery which varies according to the season and availability.

Using this model the North Carolina Division of Marine Fisheries, or a fisheries management agency in another state, can plug in different management schemes to see which works best. A management agency may want a policy that provides the most profit per unit of effort by the fishermen. Or perhaps they want a scheme that would result in greater pounds landed. Whatever the needed results, the model can test proposed and present policies to see how they stack up against one another.

Another model for fishery management that will include some work with shrimp is being developed now by Sea Grant researchers Jim Easley, Thomas Johnson and Frank Benford, all of North Carolina State University. They will be setting up a model to consider individual problems within fisheries—for example, the impact of fuel costs, market effects—and to consider problems that arise as seasons for various fish overlap.

Photo by Steve Murray



Shrimper readies nets for a day of trawling

Easley, along with two other researchers, conducted an earlier study that took a look at overlap in the shrimp fishery. While fishermen are still trawling for brown shrimp in August and September, juvenile pink shrimp are moving into the sounds in large numbers. Many pink shrimp are netted as a byproduct of trawling for brown shrimp and most are killed in the landing and sorting process. What is the cost of this incidental catch to later pink shrimp harvests? Should shrimping for brown shrimp be curtailed in these months?

Easley determined that 15 to 16 pink shrimp must be killed for every brown shrimp harvested for it to be economically feasible to curtail or close brown shrimp season. Sampling data found the ratios far below this level in most areas. Based on this data, the DMF decided to continue to allow fishermen full trawling privileges during August and September.

While Fishman and Easley map out management policies, John Maiolo and John Bort are talking to the people involved in the fishery. Maiolo and Bort are surveying shrimpers to find out why they shrimp, their views on management, their relationships with seafood dealers and marketers and their family ties to the fishery. They are surveying dealers and marketers to determine the intricacies of the marketing system and its relationship to the fishing communities. Lastly they are compiling the fishery's history, already mentioned. Some of the information they have gathered will appear in this and the following issue of *Coastwatch*.

While some people cast a cloud of skepticism over the need for such "soft" research, Mike Street is quick to defend its value to the Division of Marine Fisheries. "We need the kind of research John (Maiolo) is doing so we can know and understand the approach of the fishermen to the resource and to its management," Street says. People don't often understand, but its not the fish we manage, it's the people. John's work helps us know those people better."

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).

In the Pamlico Sound during June and July, it looked like a jellyfish invasion. Fishermen found them clogging their nets. Swimmers were leaving the water. Water-skiers were complaining of being stung, and residents were asking, "Why so many jellyfish this year?"

Frank Schwartz, a jellyfish expert and biologist at the UNC Institute of Marine Science in Morehead City, says that the "moon jellies" and "summer jellies" that people are seeing are normal summertime visitors, but that their numbers this year are "huge."

Schwartz says the unusual concentration of jellyfish has been caused by higher-than-normal salinity in Pamlico Sound, a condition favorable to jellyfish growth and reproduction there. Also, strong southwesterly winds have pushed many jellies into the upper reaches of the sound. Schwartz says the jellyfish will probably stay around until late August or September.

Although they do sting, moon jellyfish are the less pesky of the two. Their disk-shaped bodies are about 18 inches in diameter, but their tentacles are short, only a few inches long. The summer jellyfish is usually about six inches in diameter, but its tentacles are several feet long and its sting can cause pain, a red rash and, in some people, an allergic reaction.

Over on the beaches, the jellyfish to watch is the Portuguese man'o war, Schwartz says. The man'o war prefers the warm waters of the Gulf Stream, but southeasterly winds before summer thunderstorms occasionally push the jellyfish toward the beach.

Dennis Regan, a Sea Grant marine advisory agent on Roanoke Island, says that jellyfish tentacles retain their sting, even after the jellyfish is dead or washed ashore. If you do get stung, Regan recommends that you use a towel, seaweed, sand, or a knife to gently brush away the tentacles. Cool vinegar, diluted bleach or household ammonia on the affected area will help neutralize the sting, and a paste of meat tenderizer, monosodium glutamate or sodium bicarbonate can help reduce the pain. Regan says that if the pain persists, or if there is any sign of shock or serious reaction, a doctor should be consulted. Severe stings have caused cardiac and respiratory arrest, Regan says.

Ronald G. Hodson will be joining UNC Sea Grant August 1 as its new associate director, replacing William L. Rickards, now director of the Virginia Marine Science Consortium. Hodson has been with North Carolina State University since April 1973 as a research associate in the zoology department. Along with his appointment as Sea Grant associate director, Hodson will also be named as assistant professor in the zoology department.

Hodson, who has a keen interest in estuarine ecology, received his doctorate from Texas A&M University in wildlife and fisheries sciences. He received his undergraduate degree from Manchester College in North Manchester, Indiana, and his master's degree from the University of Arkansas at Fayetteville.

Besides performing administrative duties at Sea Grant, Hodson will work closely with the Aquaculture Demonstration Project in Aurora and continue to pursue his interests in estuarine research.

UNC Sea Grant marine advisory agent Dennis Regan, who works out of the Marine Resources Center on Roanoke Island, will be leaving his post August 14th. Regan, during his four years with Sea Grant, has organized an annual summer lecture series about the Outer Banks, developed a method for using hickory shad as bait, worked extensively with diving groups and associations, co-authored a Sea Grant publication, *Wreck Diving in North Carolina*, and worked closely with Dare County officials and emergency personnel to improve their awareness of beach safety problems and emergency procedures.

You may be able to name the plants in your own backyard, but how about plants in the salt marsh? To help you identify the herbs, vines, grasses and shrubs you encounter on your next trek through the marsh, Sea Grant has published *A Guide to Salt Marsh Plants Common to North Carolina*. Written by Elizabeth Jean Wilson of the Hampton Mariners Museum, the guide characterizes the salt marsh and the plants that live there. An illustrated working key helps readers discover each plant's identity.

Especially designed as a field trip guide, the 32-page booklet can be helpful to educators. To obtain a copy of the salt marsh guide, write UNC Sea Grant, Box 5001, Raleigh, N.C. 27650. Ask for UNC-SG-81-04. The cost is $1.50.

A fisherman, whether recreational or commercial, relies on good weather to get the job done. But to make sound decisions about weather a fisherman needs accurate, up-to-date information.

Jerry Davis of the Department of

Continued on next page

Marine, Earth and Atmospheric Sciences at North Carolina State University has conducted a Sea Grant study looking at the kind of weather information fishermen in this state are provided. Davis has published his findings in a new Sea Grant technical report. The report includes a listing of the marine weather services available in the state, an evaluation of these services and recommendations for improving the delivery of weather data to fishermen.

To obtain a copy of this technical report, write UNC Sea Grant. Ask for publication UNC-SG-81-07. The cost is $1.50.

You're swimming in the surf when suddenly you're pulled out to sea by a rip current. What do you do? Many swimmers panic and try to swim against the powerful current, an effort that sometimes results in tragedy. Rip currents along the Outer Banks killed five people last August and one this June.

Common in North Carolina, rip currents form when water which normally moves along the shore rushes out to sea in a narrow path. These currents can extend as far as 3,000 feet offshore, reach 90 feet in width, and travel up to four feet per second, which is faster than the average swimmer.

How do you spot a rip current? Watch for these telltale signs: a difference in color from surrounding water, a gap in the breakers where the rip is moving seaward, or a floating object that moves steadily to sea.

If you do get caught in a rip current, don't panic and don't try to swim against the current. Swim parallel to the shore until you can get out of the current and then swim back to shore. If you can't get out, float calmly with the current until it dissipates, then swim diagonally to shore.

For more information on rip currents, write for Sea Grant's colorful poster, "Rip Currents." The poster is available free from Sea Grant, Box 5001, Raleigh, N.C. 27650.

For sports fishermen ready to lure in dolphin, wahoo, tuna and marlin, UNC Sea Grant has some suggestions for a new kind of bait. Sea Grant agent Dennis Regan on Roanoke Island, along with R. C. Harriss of the N.C. Division of Marine Fisheries, worked out a method for preparing hickory shad to be used as a trolling bait for some of the large gamefish. Regan and Harriss tested the hickory shad by asking fishermen to bait their lines with the fish. The results were good.

Now Sea Grant has a Blueprint, "Using Hickory Shad as a Trolling Bait," that will tell you how to gut, brine and rig your own hickory shad for use as bait. For a free copy of this leaflet, write UNC Sea Grant and ask for UNC-SG-BP-81-5.

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Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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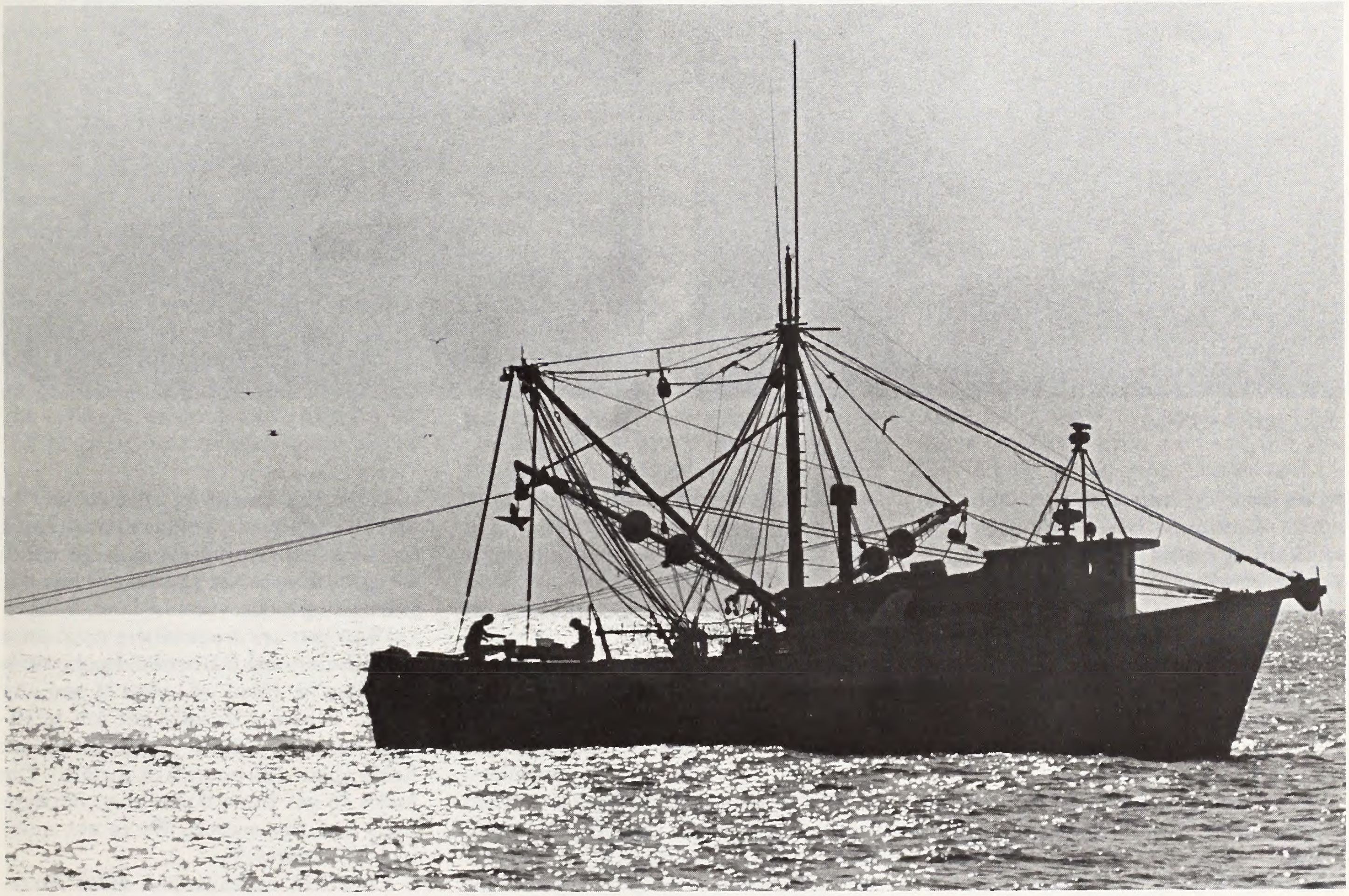
COAST WATCH

Photo by Kathy Hart



A trawler tows the line in the early morning light while the crew sorts fish

Of nets, towlines and tickle chains

With a shove the *Miss Bozy* is off from the dock. The motor revs as the propeller begins churning water to turn the 79-foot shrimp boat. After some quick maneuvers by Captain Ronald Cockfield, the *Miss Bozy* is cutting the water south to Masonboro Inlet.

The lights of Wrightsville Beach slip by as Jim Bahen and I settle in for a night of trawling. Bahen, Sea Grant's marine advisory agent at the Ft. Fisher N.C. Marine Resources Center, is picking up pointers from Cockfield.

Once through the frothy Masonboro Inlet, a high-pitched groan signals the lowering of the outriggers into trawling position. The outriggers, held to a tight V by the mast for docking and travel, open to a wide V for trawling. Wires hold the outriggers spread-eagle from the mast. The outriggers balance the trawler in rough seas and pull the nets during trawling.

Miss Bozy's stern is an island of light on the dark sea as

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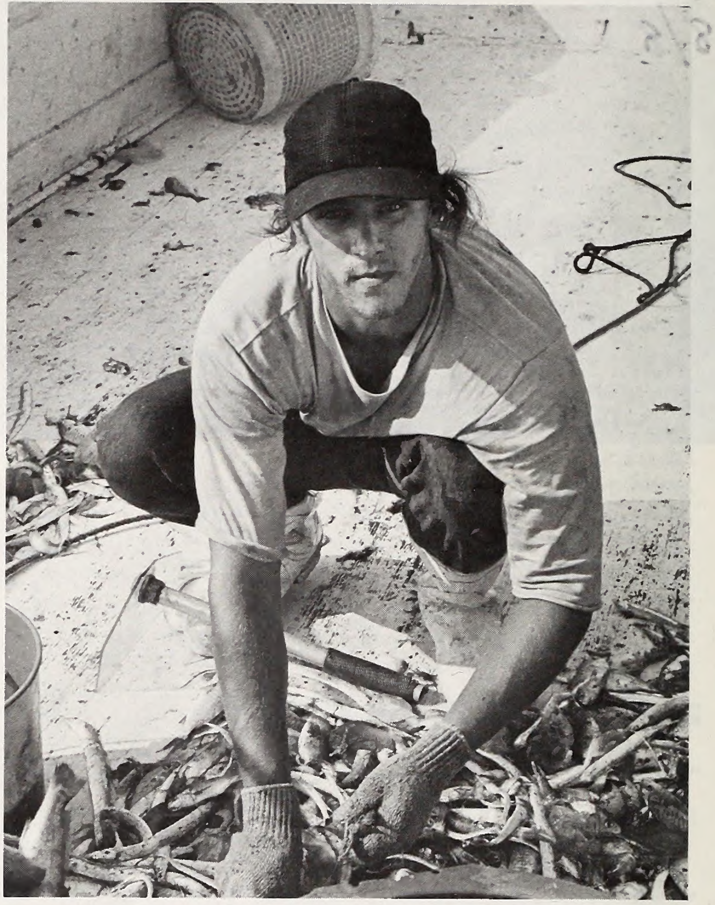
Photos by Kathy Hart

Ronald Cockfield


Charlie Powell

lights hanging from the mast and the wires illuminate the back deck for work. First mate Charlie Powell makes a final check of the nets, making sure the tailbag rope is secure. No one wants to lose a single shrimp tonight. Along the side of the boat, Powell readies the "tickle" chain, so called because it drags the ocean floor "tickling" the shrimp off the bottom and into the net.

Cockfield is running the *Miss Bozy* just offshore toward Carolina Beach. Powell points to several towers of blinking lights that emit loran navigational readings. "Ronald usually puts the nets down when we pull alongside those towers," the 20-year-old first mate says.

And to prove the first mate right, the motor slows just as the trawler pulls even with the towers. Cockfield emerges from the pilot house to help Powell lower the nets into the ocean. The sound of grinding winches fills the night air. First each set of otter doors are hoisted to the end of the outriggers. Placed at each side of the mouth of the net, the wooden doors aid in keeping the net open and on the bottom.

Next, the main body of the right net is lowered into the waves. The right tailbag follows. The procedure is repeated for the left net. The *Miss Bozy* is a double-rig trawler. She pulls two 75-foot nets.

With the nets in position, Cockfield lowers the doors into place. A marking on the steel towing line lets the captain know when the nets are the right distance from the boat and its propellers.

Off the left side of the boat Cockfield drops the try net. The try net, a 16-foot miniature version of the large nets, catches a small sampling of what the larger nets catch. Pulled up every 30 minutes to an hour, the try net gives the captain a good idea what he's catching and whether he should continue trawling in a certain area.

With all the nets in the water, Cockfield returns to the pilot house and increases the boat's speed for trawling. We soon pass another small island of light indicating another boat and crew are at work.

On this July night, just after 2:30 a.m., there is no moonlight reflecting off the water. Cockfield is glad. He catches more shrimp on dark nights.

It is the height of the season in southern North Carolina, and Cockfield is hoping for a large catch tonight. But so far the season has not been prosperous.

"My catches are nowhere near what they usually are," Cockfield says. "I'm catching a third of what I usually catch. Where I usually get ten to fifteen boxes of shrimp a night (one box holds about 100 pounds of shrimp), I'm lucky to get three boxes now. Shrimping's bad this season. We're not making any money."

Cockfield captains the *Miss Bozy*, but B. C. Costin of Wilmington owns her. Cockfield managed another one of Costin's trawlers, the *Night Train*, for six years. Cockfield says he has spent most of his life on the water. His father, also a shrimper, schooled him early in the techniques of shrimping. "I quit shrimping for a while a few years back and took up installing air conditioners," he says. "But I couldn't stay away from it. Staying on the water has a lure that keeps drawing you back."

About 45 minutes after setting out the nets, Cockfield winches in the try net. As it surfaces, Powell grapples it aboard. The try net's contents are spilled on the trawler deck. Cockfield picks through the jellyfish, small blue crabs and miscellaneous fishes to pull out 24 good-sized shrimp—a fair number for this season. Powell swings the try net back into the water and pushes the leftovers through the left scupper, an opening in the side of the trawler that allows the water to drain from the deck.

Between hoists of the try nets, Cockfield and Powell relax. Cockfield listens to the chatter of his shrimping buddies on the VHF radio as he steers the trawler on its course. Powell peruses a couple of comic books then frys up a breakfast of sausage and eggs about 4:15 a.m.

Another haul of the try net brings up 31 shrimp and, after a third test of the net about 5:15 a.m., Cockfield decides to draw in the main nets. First he cuts the engines to a slow crawl and winches the doors to the end of the outriggers. Then Powell pulls the right "lazy line" aboard. The lazy line attaches to the net at the intersection of the net body and tailbag. By using the lazy lines, shrimpers "haul back" or draw aboard the tailbags for emptying without having to bring in the main body of the nets.

The lazy line attached to the winch, Cockfield draws in the right tailbag. With the weight of the catch heavy in the net, the tailbag swings aboard in an arch. Powell quickly steadies the bag and directs it toward the culling tray where he releases the knot that holds the bag closed. Out spills a mound of fish and crustaceans. The right tailbag is tied and lowered back into the sea and the procedure is repeated with the left tailbag.

With both bags emptied, the culling tray is spilling over with the catch. While Cockfield positions the doors and prepares the trawler for a second tow, Powell, Bahen and I begin picking over the catch. Besides shrimp, Powell is keeping the flounder, larger blue crabs, squid and big spot to sell at the fish house. But most of the nettings—jellyfish, small crabs, ribbon fish and other small fish—are cast back into the ocean, a meal for the gulls and other fish.

Powell works fast. He spots the curled crustaceans with an extra sense that comes from sorting fish day after day. He tosses handful after handful into the bucket. Forty-five minutes and six gallon buckets later we're finished. We've filled just over two 70-pound baskets with shrimp. Powell transfers the shrimp to a large ice chest and shovels in fine ice. Shrimp are a highly perishable commodity that must be iced or refrigerated almost immediately after being caught.

The sun is up and a dull gray morning greets us. But the gray seems to be one that the sun will burn away. Ten trawlers are counted around us, some large like the *Miss Bozy*, others in the 35- to 50-foot range. With their outriggers spread, this fleet looks like a flock of large birds just settling on the water.

But the trawlers aren't the only fleet in evidence this morning. Another also floats in the water—cabbage head jellyfish. Cockfield says he's seen more jellyfish than usual this year. They clog his nets. (Zoologists say the jellyfish are more abundant this year because of a variety of conditions, including higher salinity levels and favorable winds.)

With daylight it's easy to see the houses that line Carolina Beach. Less than one mile offshore, the *Miss Bozy* is trawling back and forth between a point one mile north of the Carolina Beach Inlet to a point ½ mile south of the inlet. It takes 30 to 45 minutes to make the trek. Shrimpers concentrate around the inlet because the shrimp are thickest here. The inlets are the only escape from the sounds for the ocean-bound crustaceans.

Talk is thick on the VHF radio after the first haul. Captains are chattering about their night catches. One shrimper bellows out an occasional Tarzan-like yell. Powell says most of the talk centers on shrimp. "They talk about what they caught the night before and what they're catching tonight. But mostly they lie a lot," he says with a chuckle.

Powell says five years down the road he would like to captain a trawler. To be a good captain, Powell says, "you have to have a good memory and you have to be a good pilot. You have to be fair in money dealings. You have to be easy to get along with. You can't be a person who panics when you get in tight spots, like when you get nets hung."

Again the grinding winches announce the try net is being pulled in.

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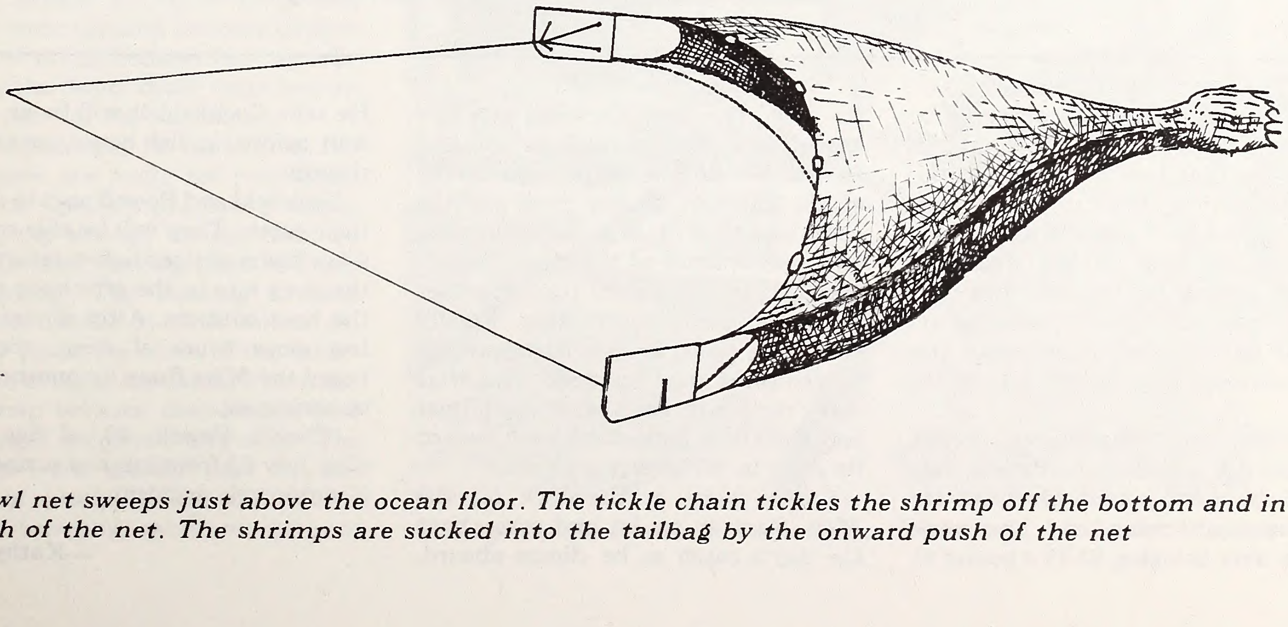
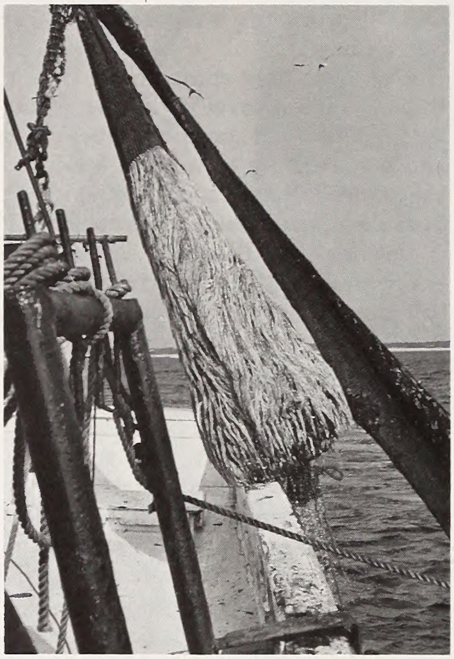


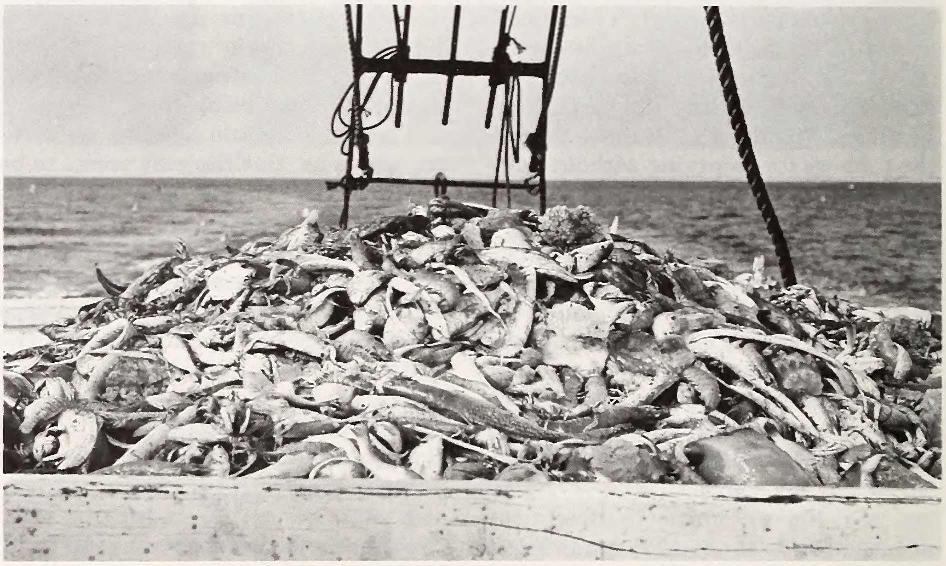
A trawl net sweeps just above the ocean floor. The tickle chain tickles the shrimp off the bottom and into the mouth of the net. The shrimps are sucked into the tailbag by the onward push of the net

Photos by Kathy Hart



The catch of the day

The tailbag is winched from the ocean to the deck. Then, like a deflating ballon, the tailbag spills its contents. They may be hard to spot, but about 150 pounds of shrimp lie among the blue crabs, jellyfish and spot.



Powell quickly springs out of the cabin to help. This time only about 15 shrimp are found in the net.

Subsequent try-net catches are low. About 9:30 a.m. Cockfield hauls back the nets and tells Powell that he's through towing for the day. His own small catches and the small catches indicated by other shrimpers over the VHF convince Cockfield to pull in his nets.

The final haul brings two baskets of shrimp. All together, Cockfield has netted about 300 pounds of shrimp for eight hours of towing time. Last week shrimp were bringing $2.25 a pound at the dock. This week Cockfield says he's expecting a little more. Cockfield and Powell are paid a percentage of the catch. But first Costin must pay the operating cost of each trip—fuel, ice and maintenance of the boat.

Cockfield and Powell team together to haul in the nets and doors. Finally Cockfield pulls in the outriggers as Powell tidies the back deck. The *Miss Bozy* motors through Masonboro Inlet and Cockfield guides the boat toward its dock in Wrightsville Beach.

Costin waits at the dock for the *Miss Bozy* to tie in, and asks about the day's catch as he climbs aboard. He tells Cockfield it will be an hour's wait before the fish house can take his shrimp.

Cockfield and Powell wait to deposit their catch. They will be able to catch a few hours of sleep before returning to the dock late in the afternoon to load the boat with ice. After dinner and a few more hours of sleep, they will board the *Miss Bozy* for another night of shrimping.

(Charlie Powell, 20, of Sea Gate, died July 30 from injuries sustained in a motorcycle accident.)

—Kathy Hart

In seafood marketing, it's who you know

Between Ronald Cockfield's trawler and your plate, shrimp are ensnared in a process called seafood marketing. A complex business based largely on telephone deals and intricate personal relationships, seafood marketing transfers seafood commodities like shrimp from the dock to the table.

As part of their Sea Grant study of shrimping in North Carolina, John Maiolo and John Bort, two East Carolina University sociologists, examined the marketing structure that surrounds shrimp.

The process begins before the shrimper leaves the dock. To keep fishermen hauling in their catch and themselves in a supply of shrimp, many dealers offer fishermen docking space, fuel, ice, repair facilities, fishing and boat supplies and occasionally a provision of credit. The exact mix of services may vary from dealer to dealer and is dependent, to some extent, on the size of the dealer's operation, Maiolo says.

After docking the catch, the shrimper is paid by the pound for his haul. The price paid by the dealers in an area is usually the same or varies by only a few cents, Maiolo and Bort report. Many shrimpers see this across-the-board price as collusion between the dealers.

But dealers see it another way. They maintain dealers are selling to the same markets so they are getting similar prices for the shrimp.

At the same time, dealers told Maiolo and Bort that uniform pricing kept the marketing business on the even keel it needed to survive. Dealers cannot afford to have fishermen shifting their supplies between dealers for better prices because varying supplies for the dealer could mean incomplete orders for his customers.

Once dealers pay for the shrimp, the crustaceans are ready for processing. In North Carolina processing means heading the shrimp, sorting them by count size and packing them in boxes for shipping. The heading is done manually, usually by older women or, in many cases, the wives of the fishermen who bring in the catch. They take the shrimp between their thumb and index finger and pinch its head off. The "headers" are usually paid by the pounds of shrimp headed, with smaller shrimp bringing more money per pound. Among the larger dealers, processing may include freezing the shrimp. The frozen shrimp are held at the processing plant until prices rise.

After packing the shrimp, dealers are ready to market their product. A dealer can sell shrimp directly to retail customers like restaurant and seafood markets or to wholesalers or processors, usually breaders.

A number of factors influences how a dealer markets his shrimp. Almost all dealers market other fish besides shrimp, usually agreeing to supply a customer with his needs for crabs, clams and oysters, in addition to shrimp.

Maiolo and Bort report that marketing patterns are generally related to shrimp size. Larger shrimp tend to be shipped to the breaders in Georgia, South Carolina and Florida. Breaders pay high prices for large shrimp, but their prices drop off for smaller shrimp.

Medium-sized shrimp (30 to 45 count) are an attractive buy for almost everyone. Restaurant buyers especially like this size shrimp because they can fill customer's plates with more shrimp for the money. Dealers sell medium-sized shrimp to retail and wholesale buyers in and outside the state. (A 1974 Sea Grant research project by John Summey reported that 55.5 percent of the shrimp caught in North Carolina were sold in the state.)

Small shrimp glut local markets in large quantities during the summer. During these periods of abundant landings local prices drop, making shrimp a more economical buy for local people. Maiolo and Bort report prices from breaders for small shrimp are very low, so selling shrimp locally is often a profitable alternative for dealers.

But no matter whom the dealer sells to, the selling-and-buying interaction is usually carried out on a personal basis. Confidence in the honesty and integrity of the man with whom you're dealing is an important factor in the marketing business, Maiolo says. When thousands of dollars of perishable seafood are committed during a telephone conversation, trust in the person on the other end of the line is vital.

Marketing, though complex, boils down to the simple concept of knowing people—the people who harvest seafood and the people who sell it.

Photo by Steve Wilson

A Wrightsville Beach fish market sells shrimp, whole and headed

A man called shrimper: Who is he?

The hours are poor. The benefits are sunburn, tired muscles and red eyes. The pay swings like a pendulum from good to bad. Who is the man who takes on this job of shrimping?

He's just under 49 years old with about 11 years of education. He most likely owns or is buying a house, is married, has two to three children and was born and raised in coastal North Carolina.

These are some of the facts gleaned from interviewing 97 full-time shrimp boat captains and 78 part-timers. The interviews were conducted as part of a UNC Sea Grant research project piloted by sociologists John Maiolo and John Bort of East Carolina University. Maiolo and Bort are trying to find out more about shrimpers and their crews so resource managers like the N.C. Division of Marine Fisheries will have a better idea of how their management plans affect the fishermen.

Maiolo, Bort and a research team interviewed fishermen in their homes in seven North Carolina fishing ports—Sneads Ferry, Morehead City/Beaufort, Atlantic, Oriental, Engelhard, Southport and Holden Beach. Assuring the fishermen their identities would not be made public, the research team asked some delicate questions about family, income and related fishing topics.

Maiolo and Bort found that a relative, usually the shrimper's father, was responsible for the fisherman's entry into fishing. The full-timers seem to have more family members involved in maritime occupations than did the part-timers.

About half of the full-time and part-time shrimpers interviewed said their wives work full or part-time, too. Thirty percent of the full-time fishermen's wives who work, do so within the fishing industry. Among the families where the wife works, she contributes 40 percent of the family income.

Most of the fishermen interviewed (79 percent of the full-timers, 93 percent of the part-timers) owned the boat they were shrimping from. Among the full-time shrimpers, 29 percent owned a second boat and 16 percent a third vessel. The figures were slightly lower for the part-timers (28 percent owned a second craft, 8 percent a third vessel).

Most shrimpers indicated shrimping was the first or second most important fishing activity of their primary vessel. Full-timers were also engaged in crabbing and clamming. Part-timers also oystered and gill-netted. Maiolo says the full-timers own a greater variety of fishing gear—nets, trawls, pots and dredges—than do the part-timers, indicating that fishing was their chief source of income.

> *"He sees his fish stocks in a state of decline, wants help from the state government on his own terms, but wouldn't change his job for anything."*
>
> *—John Maiolo*

To get fishermen to answer tough questions about income, Maiolo asked shrimpers: Given a fisherman of your experience, how much income could he expect in a good, average and poor fishing year? Maiolo believed the fishermen would base their answers on their own earnings.

Average expected earnings for full-time shrimpers are like this: $21,500 in a good year; $16,500 in an average year and $10,000 in a poor year. In a good fishing year, 28 percent of the full-timers said a fisherman of similar experience could expect more than $25,000 in income and 21 percent said they could expect to make more than $30,000. On the other hand, in a poor year, three-fourths of the fishermen said a fisherman could expect less than $10,000 in total earnings, and 44 percent said to expect less than $5,000.

Maiolo says earnings from shrimping and crabbing comprise the majority of the full-timers' income. He found 64 percent of the full-time shrimpers earn all their income from fishing and only 10 percent would quit fishing as a first alternative if conditions became worse.

Average expected earnings for part-time shrimpers are less: $11,900 in a good year: $8,200 in an average year; $5,000 in a bad year. Only six percent of the part-timers estimated a fisherman of like experience would earn more than $25,000 in a good year. Maiolo and Bort found part-timers earn 30 percent of their income through fishing—mainly shrimping and gill netting.

One complaint that ran rampant among full-timers interviewed was against fishermen who "double dip," or earn income from two sources, one of which is fishing. Maiolo says some fishermen feel these double-dippers have all the benefits of commercial fishing, but few of the hassles.

But in a survey of recreational shrimpers, Maiolo and Bort found the threat from recreational fishermen to be minimal. Based on the survey, Maiolo estimates 12,200 pounds of shrimp are caught by recreational shrimpers and sold; another 78,620 pounds are caught but not sold. Even in the worst of years (1978), Maiolo reports the recreational catch to be less than three percent of the total reported commercial catch. In 1980, a record year, it would have been less than one percent.

In light of their grievances against part-time and recreational fishermen, it is not surprising that full-time shrimpers surveyed said they would like for the state to up license fees for full and part-time commercial fishing as well as recreational fishing. "It is clear that those who make part or all of their earnings from fishing are looking to the fee structure to solve the problems associated with harvesting pressure," Maiolo says.

After completing preliminary analysis of the captain's survey, Maiolo writes, "an image of a commercial fisherman who sees himself embattled and surrounded by a hostile physical, social and economic environment has emerged. He sees his fish stocks in a state of decline, wants help from the state government on his terms, but wouldn't change his job for anything."

—Kathy Hart

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).

When farmers need a weather forecast to help them time a planting or a harvest, they often tune in to the N.C. Agricultural Extension Service's Agricultural Weather Program. Broadcast over the National Oceanic and Atmospheric Administration's (NOAA) weather radio network, the weather program adapts National Weather Service forecasts to state agricultural needs.

Two extension specialists, Katharine Perry and Gregory Johnson, prepare the agricultural forecast at North Carolina State University (NCSU). They tailor the forecasts for North Carolina's 17 weather zones, letting farmers know expected heat or cold stress for livestock and poultry, frost and freeze warnings, suitable planting dates, rain probabilities for pesticide spraying, fertilizer application, irrigation scheduling and more.

To receive these agricultural weather advisories, farmers must have a "weather" radio or a radio equipped with a weather band and tune it to one of three FM frequencies—162.40, 162.475 or 162.55 megahertz. Nine NOAA stations broadcast the bulletins in North Carolina, three in the coastal area—New Bern (11 a.m. to 5 p.m.), Wilmington (11 a.m. to 5 p.m.) and Rocky Mount (10 a.m. to noon every five minutes and noon to 1 p.m. every 15 minutes). The advisories are issued from Raleigh three times a day, 5:10 a.m., 9:35 a.m. and 3:35 p.m.

Besides offering agricultural weather advisories, the network, through the county extension agents, conducts educational programs to help farmers make better use of the advisory bulletins. For more information about the N.C. Weather Program, write for a free pamphlet from the N.C. Agricultural Extension Service, Communications Division; North Carolina State University; P. O. Box 5037; Raleigh, N.C. 27650.

If you would like to see the weather program broadened to include information specific to coastal communities, contact John Sanders, UNC Sea Grant Coastal Weather Awareness Specialist; 105 1911 Building; North Carolina State University; Raleigh, N.C. 27650-5001.

If you like crabs, you're going to love the Office of Marine Affairs' N.C. State Fair exhibit this year. There will be crabs everywhere, in all sizes, shapes and designs. And, there will even be some for tasting.

Panels and displays inside the new and larger exhibit tent will focus on this year's theme—the blue crab. The Marine Resources Centers' section will graphically display the biology of *Callinectes sapidus*, including the anatomy and many little-known facts about crabs. There will be blue crabs in aquariums and more crabs, with taped claws, in a "touch tank."

Sea Grant's section, written and co-coordinated by marine advisory agent Bob Hines, will center on the commercial aspects of the blue crab industry in North Carolina. In 1979, a record 26 million pounds of live blue crabs were landed in this state. But, if you only have a basket of crabs, staff from the NCSU Seafood Laboratory will provide a display to show you how to cook, clean and prepare crabs. There will be a limited quantity of cooked crab samples for tasting.

The Office of Marine Affairs' exhibit was designed and put together by Jay Barnes, exhibits coordinator at the Bogue Banks Marine Resources Center. After the fair, the exhibit will be placed in the three Marine Resources Centers. The 1981 N.C. State Fair is scheduled for October 16-24.

UNC Sea Grant Director B.J. Copeland was elected president-elect of the Sea Grant Association during its July meeting. The Sea Grant Association unites the numerous state Sea Grant programs along with others to create a strong national voice on issues involving marine problems.

Copeland will serve as president-elect for one year before succeeding Feenan Jennings, director of Texas A&M Sea Grant, as president of the association.

If he hopes to compete, today's commercial fisherman has to know his business, from bait prices to tax law. As Sea Grant's newest marine advisory agent, Larry Giardina will be working with fishermen and others in the state's seafood and marine industries to help them solve their business management problems.

Giardina, who has a master's degree in the economics of natural resources from Oregon State University, began work with Sea Grant in August. He is in the Marine Advisory Service office at the N. C. Marine Resources Center/Bogue Banks. His telephone number is (919) 726-0125.

The South Atlantic Fisheries Management Council will meet in Kitty Hawk, Sept. 22 to 24, at the Holiday Inn. The council develops management plans for the fish stocks in offshore waters near North Carolina, South Carolina, Georgia and eastern Florida. Regular meetings are held throughout the South Atlantic region. The public is invited to attend and ask questions or speak out on

Continued on next page

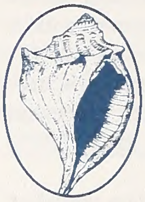
fisheries problems. For further information about the Kitty Hawk meeting, contact: Executive Director; 1 Southpark Circle, Suite 306; Charleston, S.C. 29407; (803) 571-4366.

A Wake County farmer may rub his eyes and take a second look when he sees a snowy egret standing at the edge of his farm pond. But what he's seeing is true. It seems young herons and egrets, like the young in a lot of species, have wanderlust just after leaving the nest, says James Parnell, a biologist at the University of North Carolina at Wilmington. The maturing herons and egrets leave their estuarine environment to visit the farm ponds of piedmont and eastern North Carolina before flying south to Florida and the Gulf for the winter.

The young of other colonial waterbirds like terns and gulls are also on the wing now along the coast. Once the young of any colonial waterbird species are able to fly, the colony, which is formed for nesting, disbands.

To learn more about the colonial waterbirds you may like a copy of the *Atlas of colonial waterbirds of North Carolina estuaries*, by James F. Parnell and Robert F. Soots, Jr. Published by UNC Sea Grant, the 268-page atlas provides information about the history, biology and management of colonial waterbirds in this state, along with a more specific account and picture of each species found here.

To purchase a copy of this atlas, write UNC Sea Grant, P. O. Box 5001, Raleigh, N.C. 27650-5001. Ask for publication number UNC-SG-78-10. The cost is $7.



During 1980, UNC Sea Grant began planning and funding its major research projects on a two-year cycle. An important part of that cycle is a site visit made by a panel that reviews and critiques Sea Grant's proposed programs. Sea Grant was host to a site visit last fall, and will have another in the fall of 1982.

But occasionally, research needs arise that can't wait. For that reason, Sea Grant holds funds in reserve for new, important activities. These funds can be used to initiate new projects, provide a rapid response to urgent research problems, or, in the case of "mini-grants," provide for short-term projects that test new ideas or supplement projects already under way.

Sea Grant's director, B.J. Copeland, recently awarded two new mini-grants. Lundie Mauldin, Sea Grant's marine education specialist, will receive $700 to establish microcomputer programs with marine concepts. Designed for museums and school systems with microcomputers, Mauldin's project will provide marine education through two "games." Students can choose to learn about underwater habitats and diving or the energy balance in coastal ecosystems. Mauldin is coordinating the work on this project with John Tashner of the Division of Science Education at Appalachian State University.

A $960 mini-grant was awarded to Bob Hines, a marine advisory services agent with Sea Grant, to set up a demonstration for North Carolina's commercial fishermen on a new hydraulic net lifter. Hines recently traveled to Maine to talk with manufacturers and examine the equipment he'll bring back to use in the demonstration. Hydraulic net lifters save labor for fishermen with gill nets and long-haul nets. They also outperform conventional gear in rough water and in cold weather.

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COASTWATCH

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Photo by Neil Caudle

Sailboats at a marina near Minnesott Beach

A door for folks afloat

A place to tie your boat and step out. A repair shop, gas station, warehouse, boat dealer, laundry, restaurant, lounge, tackle shop and social club. A place to gather and shoot the breeze; a place to catch the next breeze out.

The definition of marina is as new as the word, but saying what marinas are is much harder than saying what they do: they link people to the water.

"Marinas are the doorways to the waterborne public," says Leon Abbas, Sea Grant's marine recreation specialist. Abbas has spent years studying and promoting the economic health of the marina industry in North Carolina, an industry he says is critical to the state's coastal economy.

The industry is young, Abbas says, but growing: There are about 150 marinas operating along the coast, representing a value in excess of $60 million. They range from small, family-owned businesses with a few slips to luxurious operations complete with condominiums, yachts and club houses. They cater to fishermen on the sounds, blue-water sportsmen, and yachtsmen passing through. They can store about 10,000 boats.

And, demand for the services marinas offer is very high. Inlanders tired of burning fuel to haul their boats between the coast and home want coastal storage for their boats. More of us have leisure time for boating.

But all's not well with marinas. Most of them are built on shorelines bathed by tides, where marine life is most sensitive to disruption.

There is evidence that the dredging around marinas can threaten fish. There are shellfish waters closed to fishing because of contamination from marinas. There are public waters practically closed to public navigation because they are clogged with marina docks and mooring posts. And, to deal with problems like these, there are newly proposed regulations that have some marina owners upset.

This month, Coastwatch *takes a look at the state's marina industry and the issues surrounding it.*

New rules wouldn't sink marinas, state says

What both sides want is a peace treaty, not a war. But sizing up the issues, a cynic might predict the worst.

On one hand are the marina operators, by most accounts some of the hardiest and most independent men and women doing business in North Carolina. One of them said: "Regulations are like poison darts; the more they let fly, the more likely you'll get stuck."

On the other hand is the Office of Coastal Management, the regulators. They have the responsibility of protecting the coastal environment for the common good, and they intend to regulate how marinas affect that environment.

In fact, there has already been one skirmish, over a new set of standards proposed by Coastal Management at a meeting of the Coastal Resources Commission in July. Marina operators present at the meeting took issue with the proposals and accused Coastal Management of trying to regulate marinas out of business.

"We were taken aback," says Preston Pate, director of field services in Coastal Management's Morehead City office. "They said we hadn't made an effort to get their opinions, and we felt we had." Pate says that on June 26 he sent out 140 copies of a letter to members of the marina industry. The letter included copies of the proposed standards and asked for comments before the July meeting.

"I got one written comment and one phone call," Pate says. He says the lack of response led him to believe that most of the operators were reasonably satisfied with the proposals.

But marina operators point out that the letter came during their busy season, when all but the most pressing mail stacks up on desks, unopened. After hearing the marina operators' complaints in the July meeting, the commission moved to postpone approving the standards until later this year, after marina operators had had more time to respond. The proposals were to have been discussed at the October meeting of the commission. If approved, they will be aired in public hearings and could be adopted as early as December.

Gene Floyd, a Wrightsville Beach marina owner and president of the N. C. Marina Association, says several of the standards, as written, could have the effect of stunting new growth among North Carolina marinas. Floyd cites one standard that would prevent marinas from being situated within 500 yards of shellfish beds. "You can find a clam just about anywhere," Floyd says. "And you could use that rule to stop just about any marina."

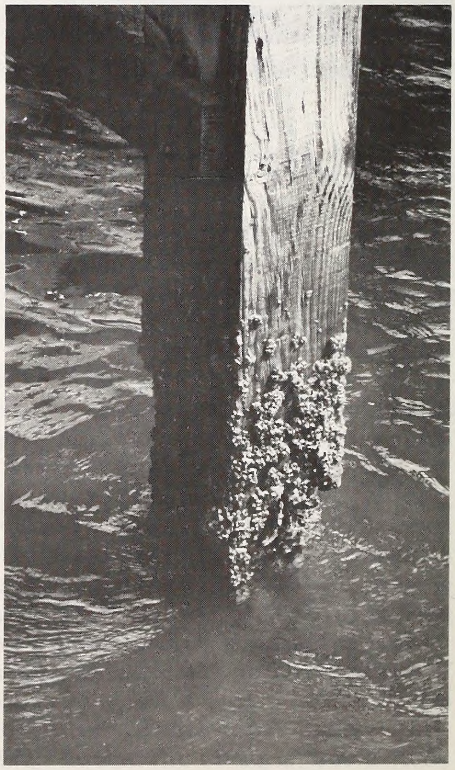
Floyd and others also feel that the new standards will further complicate the process by which new marinas are granted construction and operating permits—a process they say is already too time-consuming.

"It takes everything from six months to a year to get anything done," Floyd says. "We don't think we need all this regulation. For example, we're concerned about water quality, because we live with it every day. A lot of operators are voluntarily putting in grease traps, and we're coming up with our own ideas about pumpout stations."

Preston Pate says the proposed standards were never intended to discourage new marinas.

"I don't think what we're doing is going to have that effect," he says, "and it's not an attempt to change the operations of any existing marinas. Our coastal program recognizes marina development as an integral part of the coastal communities. But we have seen some development that does not exhibit the wise use of the resources we have."

Photos by Neil Caudle



Dry-stack marinas like this one near Atlantic beach store many boats efficiently. But at any saltwater marina, maintenance is a problem. Damaged pilings like the one at right, from a marina near Morehead City, must be replaced before the structure becomes unsafe.

Pate says the proposed standards speak to the three key issues concerning coastal marinas:

—Dredging, which is necessary in most marinas to keep channels open, increases turbidity and can put some fish at risk. "One of the big problems is locating marinas in shallow, tidewater creeks that offer protection from storms, but also carry the necessity to dredge for maintenance and expansion," Pate says. "Traditionally, these small tidal creeks are some of the most productive areas, and dredging changes the character of the nursery areas significantly."

—The construction of marina docks and slips in public waters is another serious issue. Pate notes that many marinas freely use publicly owned waters for building sites; he lists several cases in which marina operations actually block waterways to other traffic. Coastal Management has asked the N.C. Department of Administration to decide how the state should regard such construction in public waters, and has suggested the state employ a leasing program. But the Department of Administration has not acted on the recommendation. Pate says that an obstruction of public waterways could be challenged in court, unless some sort of formal leasing program is begun. In lieu of such a program, he says, "we have the responsibility of holding these public areas in trust for the use of all the public."

—Waste disposal and water quality around marinas are also stubborn problems in North Carolina, as they are in other coastal states. Because they are a gathering place for people, even well-managed marinas produce some contaminants, if from no other sources than the rainwater runoff from parking lots and rooftops.

Coastal Management's reluctance to endorse publicly owned, open-water sites on sounds and creeks leaves the office with standards that tend to favor shoreline basins partly surrounded by high ground.

Spencer Rogers, Sea Grant's coastal engineering specialist, has responded to Coastal Management's proposed standards, and has expressed reservations about endorsing basins over open-water sites for marinas.

Rogers points out that research into the question of how much marinas contaminate nearby waters is still inconclusive, but there is some evidence that open-water sites create fewer pollution problems than mostly enclosed basins. A study funded by Virginia Sea Grant at the Virginia Institute of Marine Science found that water samples taken near a marina showed no significantly higher bacteria counts than samples taken farther away. Other studies have shown very high coliform bacteria counts in more nearly enclosed marina basins, where water circulation is not as good.

"It seems as if local hydrography has more to do with water quality than being near a marina does," Rogers says. He points out that basins tend to concentrate contaminants, not only from marinas, but from other sources such as septic tanks and industry.

"In order to minimize the ecological impacts, what you would do is to design the marina for a maximum of wind or tidal flushing and a minimum of dredging," Rogers says, "and that would mean an open-water site. But that encroaches on the rights of others trying to use the water, by obstructing public-trust waters. So that leaves you with the question of what serves the public interest best—having marinas on the open-water sites, or preventing them there?"

Gene Floyd's answer to that question reflects the marina operators' view: "We feel like we're a necessary industry for people who want to use the waters," he says. "We provide a service. Without us, the public would have a hard time getting access to the water at all."

Coastal Management had already dropped, before the July meeting, one of its most controversial marina standards. The standard required marinas to provide pumpout stations for removing wastes stored aboard boats.

"It was a tremendous enforcement problem," Pate says of the requirement. "It only applied to new marinas, and we found that, where the pumpouts were put in, there was very little use of them. Some were never used at all."

Pate says that the pumpout requirement was meant as a companion to the U. S. Coast Guard's new regulation forbidding boats to discharge untreated waste through their hulls into nearshore waters. In order to comply with that regulation, most boaters would have had to outfit their craft with expensive treatment systems or somewhat less expensive onboard holding tanks. Since the tanks have to be emptied, Coastal Management felt marinas should be required to provide

Continued on next page

Industry finding voice, clout

Just two years old and 30 members strong, the North Carolina Marina Association is like a growing adolescent, testing its new muscles and finding its voice. But the association's president, Gene Floyd, insists the group was not formed "to fight city hall."

"We don't want to build a barrier between us and the agencies we deal with," Floyd says. "We give credit to Leon Abbas (Sea Grant's marine recreation specialist) for helping us see the need for working with these agencies, not against them."

The association made Abbas an honorary member for his role in helping the group get the information it needed to organize itself and find its identity. Abbas says the marina association is teaching the industry that it can communicate and solve some of its problems, collectively. Before the association, Abbas said, "there was a feeling of isolation, since they are geographically isolated."

Floyd says the association is tackling some routine business matters, such as how to secure group insurance rates, but has also found that its voice can publicly represent the interests of the industry. When, during the Carter administration, a ban on weekend boating was proposed as one of the standby measures states might employ during an energy crisis, the association's members spoke against the plan during a public hearing in Raleigh. They were heard, and North Carolina's energy office dropped the ban from its list of options.

"What they've found is that they are not alone," Abbas says. "They can find more solutions through cooperation than they can individually."

pumpouts, a measure designed to help ensure that tanks' contents were disposed of properly. But as Pate points out, so few boaters have complied with the Coast Guard's rule that the pumpout stations often go unused.

"We didn't want to get into the position of closing somebody's marina down because he didn't have a pumpout station, since they weren't being used anyway," Pate says.

Instead of the pumpout rule, Coastal Management is proposing a standard that would require marinas to display, on a sign, the location of the nearest pumpout station.

(Spencer Rogers has also been working on the waste-disposal problems of boats and marinas. His design for a low-cost holding tank for boats is aimed at helping boaters comply with Coast Guard regulations. The tank is portable, and can be emptied into most any sewerage system. For details about Rogers' design, write for Sea Grant's free Blueprint, *The $10 Holding Tank*, and ask for publication number UNC-SG-BP-80-1. Rogers is also designing a portable, hand-operated pumpout unit that could be rolled along the dock and cost less than a pumpout station.)

But despite the rough sledding during the July Coastal Resources Commission meeting, both Pate and the marina operators seem to believe the two sides can reach agreement.

"The main concern we have," Floyd says, "is for us to be able to work together, so that we can help in the regulation of our marinas."

And Pate adds that the proposed standards are not hard-and-fast rules. Most are written to express preferred conditions, not absolute criteria. They are also written to give coastal communities a framework for their own marina policies.

"One thing we're trying to encourage is communities taking a closer look at marina development," Pate says. "If a marina is proposed, and it is compatible with a community's land-use plan, then that provides some justification for marina development there."

Susan Schmidt, a research scientist with Coastal Management, has conducted much of the study necessary for preparing the new standards, and she thinks her agency actually supports marina growth in the state. "Marinas are needed," she says. "They do a service, they provide access to the water. As a matter of fact, we give preference to marinas over other businesses that could just as well be built somewhere other than on the shoreline."

—Neil Caudle

Photo by Neil Caudle

Keith Wolfenbarger on his pile driver

Three marinas, Minus one

For those who love boats, the job might seem made to order: days spent among sails and outboards, chatting with fishermen. But there's more going on at a marina than atmosphere, and perhaps the closest parallel to the job is farming: long days, risks, and bone-tiring labor.

Here are the stories of three North Carolina marinas: a new one catering to sailboats and surviving its growing pains, another for the motorboaters, thriving in a busy beach town, and a third that never made it off the drawing board.

Keith Wolfenbarger rocks back on the lever. With a deafening clang, his pile driver hammers a new piling into the harbor. It's not the sort of gear you see doctors using every day; but this doctor is weaning himself away from medicine. He's building a marina.

"We're having fun, doing this on our own," Wolfenbarger says, "although I'd have to say it's not very profitable, yet. But we have filled up our marina, and we're building on."

For now, the story of Keith and Judy Wolfenbarger's marina near Minnesott Beach seems destined for a happy ending: permits are in hand, new boat slips are rented and full, and word is getting out about the place. But in the early going, there were several chapters of adversity.

Elaborate tie-ups with construction crews kept work stalled until the Wolfenbargers decided to finish building the place themselves, they say. There was also a disagreement with a country club that wanted to put a pier into the channel serving the marina. The question was resolved, Keith says, when he offered the club a boat ramp in place of the pier. And, getting the permits they needed took twice as long as they had expected.

"We really did have constant interference the first six months here," Judy recalls. Their problems getting permits were not insurmountable, though, partly because their site was well-suited to the marina. The basin was surrounded by high ground, there was good access to the Neuse River, and some of the necessary dredging had already been done by previous owners. They say that most of the regulations they faced made sense to them. They cite the required pumpout station as an example.

"I don't see that a pumpout is that much of a problem," Keith says. "If this marina had two hundred boats in it, each one dumping, you'd be sitting in a cesspool. We make 'em pump. But they don't seem to mind; after all, their kids swim here."

Like other sailboat marinas, the Wolfenbarger's trade is built on the rental of slips, wet-storage spaces where boats are moored. The average rental fee for a slip is about $50 a month. But most sailing families spend much more at the marina in boat maintenance, for goods in the ship's store, and for use of the laundromat and pumpout station.

"You can do a little mental calculation with those figures, multiplying them by the two hundred boats we'll eventually have here, and come up with some impressive numbers," Keith says. "But you plow most of that right back into the business. You have to."

"After all those years playing supermom back in Kansas, this is quite a change," Judy says. "We love it, but you give up some things. The pile driver and the truck were my Christmas presents last year."

Their marina is built, but Jerry and Kathy Macon's workdays still outlast the sun. Like the Wolfenbargers, and many other North Carolina marina operators, theirs is a family business.

"I get dirty and she does the paperwork," Jerry says.

The Macons are the operators and part-owners of a large dry-stack marina at Atlantic Beach. The marina caters to power-boat enthusiasts and fishermen, and its storage building holds 136 boats in racks. An $80,000 lift truck shuttles boats between storage and the water. Rates for storage run from about $500 to $700 a year, depending on the size of the boat.

Their racks have been full for four years, and the Macons say demand for boat storage is so great that "for every customer we have at least one waiting." But he adds that storage fees alone would not pay the bills. Fuel sales, merchandise sales, a used-boat brokerage and repairs help make the business profitable.

"Repair work means the difference between going a shade in the red and going into the black," Macon says. "If you don't do service work, you'd have a hard time making it. The whole business falters when you have a boat not running, because you're not selling gas or supplies, and the customer is not satisfied."

The repair work was something Jerry already knew something about when, in 1976, he and Kathy left their jobs in Raleigh for the chance at a life near the water.

"I came down here because I wanted to be around boats and the water," Jerry says. "Now I never have the time to get out in a boat the way I used to. But I still enjoy the business."

Photo by Neil Caudle

Jerry and Kathy Macon

Their business is in good shape, but as Jerry says, "you never have it knocked." Supplies of repair parts dry up and leave him with angry customers. Costs are rising at a dizzying rate. And, being near salt water doubles the maintenance around the business.

Despite their success, the Macons hesitate to offer much hope to anyone planning to build a marina, even though they say there's enough demand to support many more such businesses in North Carolina. "The market just won't bear the cost of a new facility," he says. "The interest rates are too high now, and the cost of waterfront property is astronomical."

The Macons are members of the North Carolina Marina Association, and they say the group will help improve the image of marinas in the state. "A lot of people, when they think of marinas, they think of an old railway for hauling out boats. They think of old paint cans and piles of engine parts lying around. But this is a different kind of business. It's a good use of land because in less than three acres we're giving a hundred and seventy families access to the water."

Neil Barnaby has given up trying to build his marina. Barnaby arrived on Cedar Island in 1978 with his savings, his family and a notion. He wanted to create, on the water, a small village suited to fishermen.

He planned to build some multi-family housing, heated mostly by the sun, clustered around docks and a marina for the community's boats—a mixture of pleasure craft and commercial fishing vessels. He says he wanted the housing to be priced within reach of the islanders. By his account, the community liked the idea, and he says local and state officials encouraged him.

Barnaby bought 33 acres, including a house and a saltwater basin known as Great Pond. The pond, he was told, had only recently been opened to Bogue Sound by a channel dredged by previous owners. Local fishing boats had been using the pond for a harbor, tying up at makeshift docks.

Barnaby says he planned to improve water circulation in the pond, which

Continued on next page

Photo by Neil Caudle

Neil Barnaby with beleaguered blueprints

has been less than pristine, and build better docks. He says he promised local fishermen places at the docks for nominal fees. The fishermen could have one side of the basin, he reasoned, and the pleasure craft the other. An engineer by training, he drafted his first set of plans himself.

That was three years and more than $150,000 ago. Today, Barnaby has little more than he began with, except blueprints and some small ball point pens imprinted with the name Mariners Village.

"We came to a crashing halt last October," Barnaby says. "This has been a nightmare. I have spent my retirement money, and I've been frustrated in more ways than I can count."

The story he recounts reads like a badly written Russian novel—a tortured plot and too many characters. As staff would come and go in various agencies, he says, new personnel would confront him with new requirements. After two years of drawing plans, meeting with officials and paying consultants, survey teams and architects, Barnaby hit a wall. The Office of Coastal Management told him it could not approve his permit, he says, until the N. C. Department of Justice confirmed his title to the basin. Justice decided the pond had, in the past, been navigable, and had been under tidal waters. Justice said the pond was therefore in public trust.

Barnaby says he hired a survey team whose work, he says, concluded the pond should be his. Armed with petitions signed by local residents and old photographs that he says showed the pond had not been tidal, Barnaby took his case to the state. The Attorney General's office stood firm.

With his money running out and no solution in sight, Barnaby scrapped his marina project and decided to build something more profitable: condominiums. He turned the project over to a landscape architecture firm in Raleigh.

Charles Jones, a field consultant with Coastal Management's office in Morehead City, did much of the field work on Barnaby's project. "I don't think Mr. Barnaby is a good example of how the process works," Jones says. "There were so many problems, so many complications with his site. In the beginning, I think the first people he met with made some suggestions to him, primarily dealing with water quality. I think he construed their suggestions to mean that everybody was approving his project."

Jones says that even if Barnaby's ownership of the pond had not come into question, there were other problems facing the project. "He wanted to fill in some areas to create a beach, and that amounts to open-water disposal," Jones says. "And, there's a shellfish lease directly in front of his property."

Jones says that much of the delay in the project was due to frequent revisions in Barnaby's plans as new consultants took on the projects.

"With something as complex as this, there are no hard-and-fast guidelines," Jones says. "It's very site-specific, and any change in the plans changes the complexion of the project."

John Parker, Coastal Management's permit coordinator, says the Barnaby project was delayed some because the plats Barnaby supplied were poorly copied. He says the plans took the same route other such projects do: ten state offices had two weeks each, plus possible extensions, to review and comment on the plans. (Those offices are: Coastal Management, Property, Archives and History, Community Assistance, Land Quality, Health Services, Transportation, Environmental Management, Wildlife Resources and Water Resources. A similar number of federal agencies comment to the U.S. Army Corps of Engineers.) Parker says Barnaby's marina plans ran into trouble because several of the offices had reservations about the project, including Environmental Management, which did not like the looks of the sewage-disposal plans.

"If it's a controversial project, it takes longer," Parker says. "Most marina projects can be approved or denied in about sixty-five days."

For Neil Barnaby, it took three years, and that, he says, is his gripe. "If, three years ago, somebody had told me all the steps I had to take, all I would have to go through, I would have never tried this at all. I would have never spent all that money," he says.

Anyone thinking of buying coastal property or building a marina can call on one of Coastal Management's field consultants, who will make a site visit and point out potential problems, free of charge. Todd Llewellyn, the agency's information officer, says his office is preparing a publication outlining the steps in the permitting process.

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).

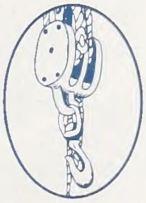
Whoever thought research is only done in laboratories hasn't seen UNC Sea Grant researcher Charles Peterson on his hands and knees in the Bogue Sound marsh, sifting the sands for hard clams. Peterson, a researcher at the Institute of Marine Sciences in Morehead City, is looking at the management of the hard clam fishery in this state with special emphasis on the effects of various harvesting methods.

Each clam that Peterson turned up in his Bogue Sound search was dotted with paint and returned to one of 30 one-meter plots. Half of the plots were covered in Cuban shoal grass while others were stripped of their grass and the clams left in bare, sandy bottoms. The test? To see how sea grass cover affected predation of hard clams by whelks (often mistakenly called conchs).

Peterson gave the experiment six months. Meanwhile he did some detective work in the laboratory. He fed clams to whelks so he would be able to determine what kind of evidence the predatory whelk left behind.

After determining the clues of whelk predation, Peterson went back to sound to sift the sands. He found that hard clams, who had the cover of sea grass, fared well. But many of those hard clams left in bare, sandy bottoms were eaten. During the six-month experiment conducted during cold weather, 32 percent of the hard clams left on the sandy bottom were eaten by whelks. Peterson repeated the experiment during four warm months, finding 70 percent of the hard clams in sandy areas preyed upon by whelks. Peterson says the higher summer mortality resulted from increased whelk activity, an increase characteristic of most marine creatures during warmer months.

What does all this mean? Grass beds denuded by raking and clam kicking can not only deprive young fishes of needed habitat, but it also sets up hard clams as a more likely target for predation by whelks.



Fishermen, marina operators, seafood dealers and others have a new source of information. Two Sea Grant marine advisory agents, Bob Hines and Larry Giardina, have published the first issue of a newsletter designed for people who use the state's marine resources. The newsletter, which will be published monthly, will offer news about research, advances in gear and methods, regulations, and programs and events of interest. To receive this free newsletter, contact the UNC Sea Grant Marine Advisory Services, P. O. Box 896, Atlantic Beach, N. C. 28512, or call (919) 726-0125.

Available: prime laboratory space in three desirable coastal locations. Utilities and some furniture and equipment included. Access to boats, darkrooms and holding tanks. Rent: based on tenant's ability to pay.

To scientists accustomed to overcrowded campus labs, an announcement like the one above might seem too good to be true. This one, however, is for real. According to Doug Young of the N. C. Office of Marine Affairs, there are four labs available in each of the three N. C. Marine Resources Centers (at Ft. Fisher, Bogue Banks and Roanoke Island). Young says the labs are offered to qualified investigators conducting studies pertinent to problems associated with coastal and marine resources. The offer is not limited to North Carolina investigators.

Three projects are currently underway in the centers. One of them, Project CAPE, a program directed by Carolyn Hampton of East Carolina University (ECU), is using space at the Roanoke Island center to develop teaching materials in marine education for Dare County public schools.

Qualified researchers interested in space at the centers should inquire to J. C. Jones, director, N. C. Office of Marine Affairs, 116 W. Jones Street, Raleigh, N. C. 27611.

To give some inland extension home economics agents a taste of the sea, UNC Sea Grant and the N.C. Agricultural Extension Service sponsored three days of in-service training in October at the NCSU Seafood Laboratory at Morehead City. Sea Grant staff at the lab, Frank Thomas, Joyce Taylor, and Sam Thomas, along with extension personnel, told the agents about how nutritious and economical seafood can be, and gave them tips on how to preserve and prepare it. Then, for some hands-on experience, the extension agents learned how to fillet fish, steam crabs, and pry open oysters.

Armed with their new seafood knowledge, the extension agents returned to their inland counties prepared to spread the world about seafood.

Problem: how to design a tent for camping on the beach. Requirements: must be economical, light weight, durable and weather-tight. The occasion was an October field trip for 19 students in

Continued on next page

Lundie Mauldin's course, "Oceans," at NCSU. The group traveled to Cape Lookout National Seashore with Mauldin, Sea Grant's marine education specialist, and Stan Riggs, a geologist from East Carolina University. They were there to study island ecology, shoreline processes and the predicament of the Cape Lookout lighthouse, which has been threatened by erosion.

"We also wanted them to see what it's like to rough it on an island beach," Mauldin says.

Teams of students were left on their own to design tents using only sheets of plastic and walking sticks. That night, the creations got a stiff test: a driving rain came, and the wind blew at 25 knots. All five tents held firm, though, and the students stayed dry. Many conventional tents, Mauldin says, would have failed. She says the students succeeded because their tents' low, sloping profiles deflected wind, and because the tents were well-anchored by piled sand.

"Their shelters reflected the students' ability to work with the wind forces and the lack of a stable base," Mauldin says. "They had to be observant, and they were."

Erosion is a serious threat to waterfront property along the estuarine shoreline. Some effective methods of erosion control, such as the use of bulkheads and groins, can be expensive to construct and maintain. But, in some areas, property owners can use an inexpensive, natural buffer against erosion: transplanted marsh grasses.

Sea Grant's new publication, *Planting Marsh Grasses for Erosion Control*, provides guidelines for the property owner interested in this natural erosion-control method. Types of grasses are discussed along with choosing suitable sites, transplanting, fertilizing and maintaining a fringe of marsh grasses. Information on growing grasses from seed in a greenhouse is also included. All of the information in this booklet has been tested by the authors, S.W. Broome and W.W. Woodhouse, Jr. of the Department of Soil Science, and E.D. Seneca of the Department of Botany at North Carolina State University. The three recently completed a Sea Grant project that produced much of the information in the booklet.

For a copy of this free publication, write Sea Grant, Box 5001, Raleigh, N.C. 27650-5001, and ask for UNC-SG-81-09.

Fishermen and many other seafarers can no longer receive free health care from the U. S. Public Health Service. As of Sept. 30, patients who once qualified because they operated or helped operate vessels registered by the U. S. Coast Guard will have to find medical attention on their own.

The Omnibus Budget Reconciliation Act of 1981, approved in August, ended the entitlement and provided for the closure or conversion of all Public Health Service hospitals and clinics.

The Public Health Service hospital in Norfolk, Va., which has admitted thousands of seafarers each year, is now closed. Retirees of the uniformed services, and dependents of active and retired members of those services, will be given general care only as outpatients in what is now called the Lafayette River Branch Clinic.

Estimation of Surface Gravity Waves from Subsurface Pressure Records for Estuarine Basins, by C. Ernest Knowles of the NCSU Department of Marine, Earth and Atmospheric Sciences, is the latest in a series of Sea Grant working papers.

To receive a copy of this working paper, send 75 cents to UNC Sea Grant. Ask for publication number UNC-SG-WP-81-6.

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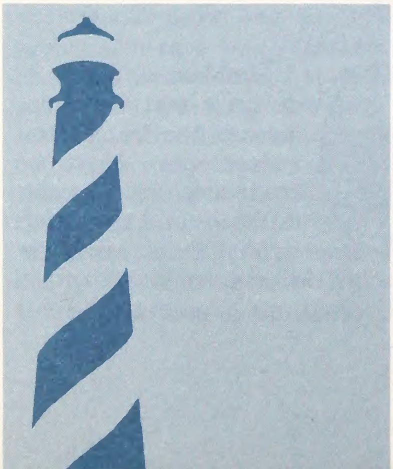

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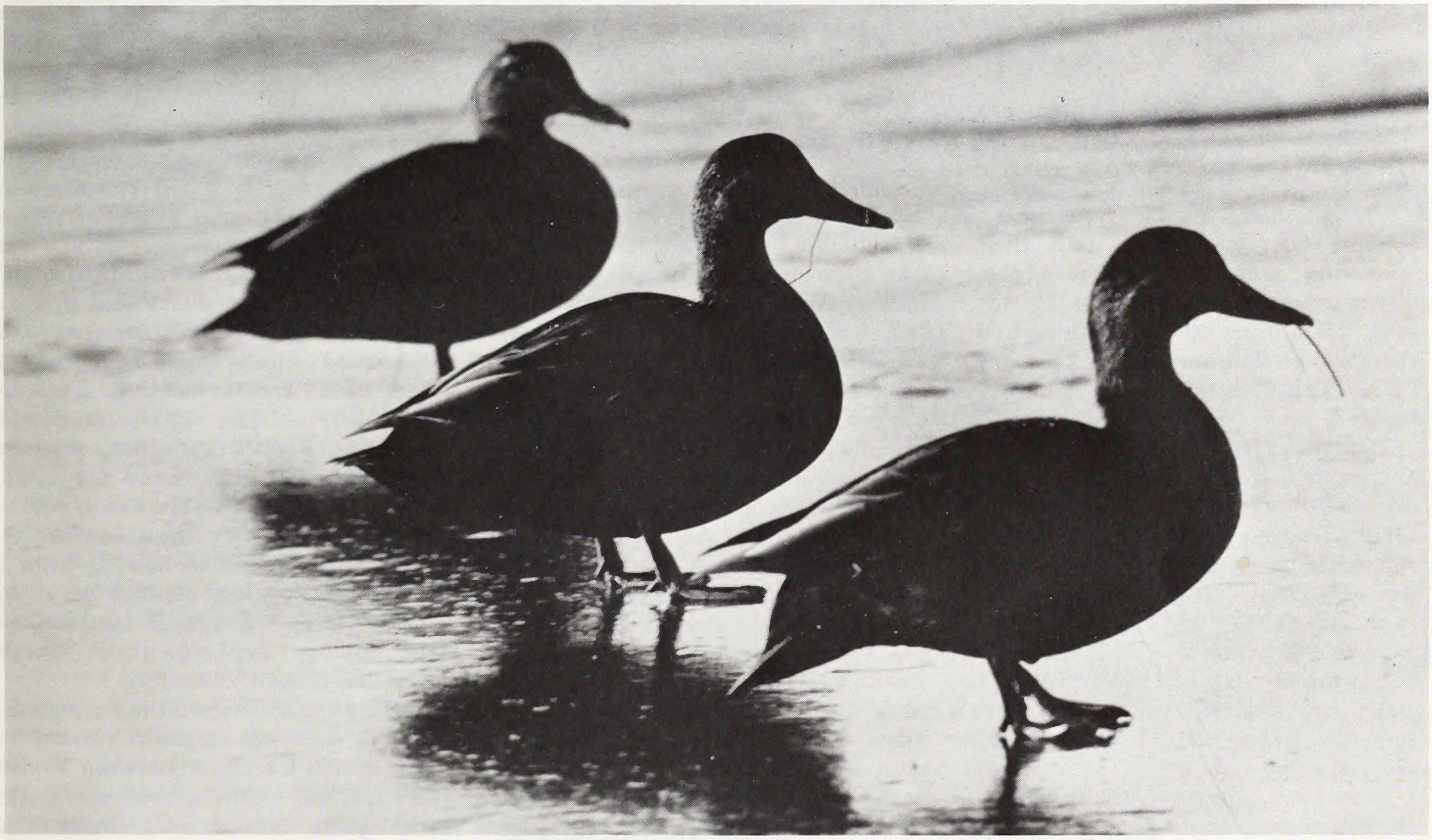
Photo by Michael Halminski



Three companions search the frozen sound for a bite to eat

Autumn settles in on a cloud of southbound wings

Let the first chill of autumn sidle over North Carolina and you can bet thousands of waterfowl will be setting their wings southward. Some ducks, geese and swans merely pass through the state en route to a more southerly destination, but thousands of waterfowl skitter into North Carolina lakes, marshes and sounds for the winter.

By late December, mallards, black ducks, wigeons, teals, Canada geese, whistling swans, pintails, redheads, canvasbacks and more have settled into areas like Currituck Sound, Lake Mattamuskeet, Pamlico Sound and the lower Cape Fear River. There, they fill their bellies with marsh grass, wild celery, acorns and occasional "leftovers" from a farmer's corn crop. And about the same time, they become targets for hunters.

Hunting season is intermittent in this state with opening and closing dates and bag limits set by the N.C. Wildlife Resources Commission. The populations of some species such as whistling swans and canvasback ducks (in certain areas) are low and are protected from hunting.

The early arrivers each fall are the blue-winged teal. They wing in during late September and early October. The peak for duck season is mid-November, says Steve Frick, refuge manager at the Lake Mattamuskeet National Wildlife Refuge. Geese arrive by early December, while swans make their debut around Christmas, he says.

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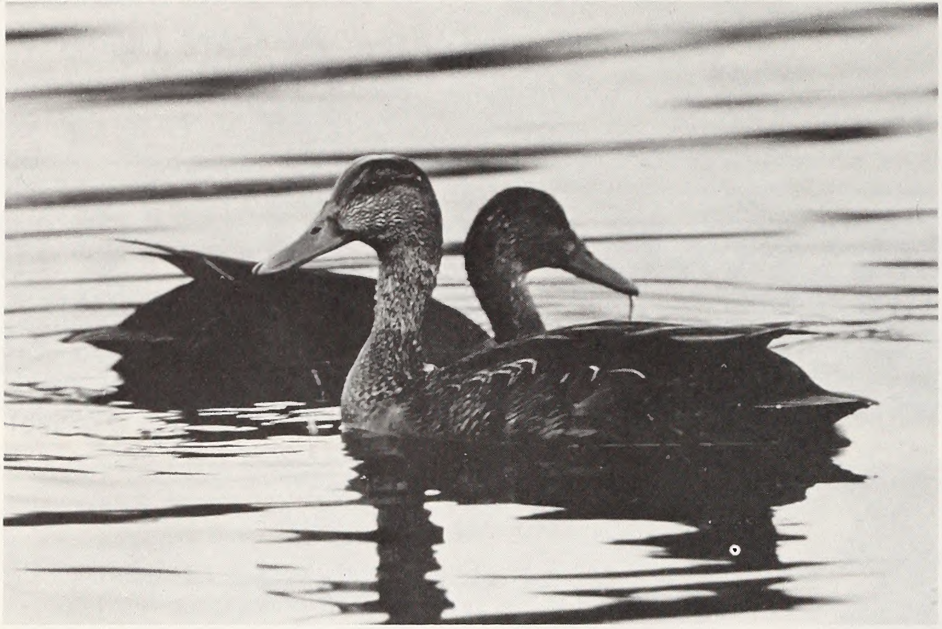
Photo by Michael Halminski



Green-winged teal preparing for take-off

Some waterfowl move into their wintering areas during the night. "They migrate on the moons," Frick says. "You'll get up one morning and there will be thousands of ducks on the refuge that weren't there the day before."

Dick Brame, a waterfowl biologist at North Carolina State University, says the snow goose will migrate thousands at a time, day or night, usually riding the coattails of a good northwester. "They migrate in high Vs," he says. "When they reach the place they want to overwinter they fall like leaves out of the sky. It's like free falling. It's called whiffling, and the geese are letting the air out of their wings. They seem to enjoy it, but I don't know how I know that. They also make a noise that sounds like a high-pitched dog at a distance. They're so loud in a flock you can hardly hear yourself think."

Scoters, which are sea ducks, migrate only during the day, Brame says. They migrate offshore, forming a line just above the water. "When the scoters come across an obstacle like a boat they fly over it one after another," Brame says. "It looks like someone has snapped a rope."

Brame says five groups or tribes of ducks can be spotted in North Carolina. Diving ducks (Aythyini) such as canvasbacks, scaup and redheads will dive to depths up to 60 feet to snack on widgeon grass or Rangia clams. A distinguishing characteristic, diving ducks' feet are located to the back of their bodies to help them dive.

Dabbling or puddle ducks (Anatini) won't go to such depths for their meals. Mallards, pintails, wigeons, teals and black ducks feed in shallower areas where they need only "tip up" (so their tails are above water) for a taste of pondweed or bulrush seeds. Dabbling ducks' feet are located more forward on their bodies allowing them to walk easily on land and occasionally feed on the remains of harvested crops such as corn. Like a helicopter lifting off a launch pad, dabbling ducks rise straight off the water when taking flight. And one of the dabbling ducks, the black duck, adds a little dazzle to his lift off. According to Brame, as the black duck raises his wings against a blue winter sky, the silver underlinings of his black wings twinkle in the light.

Scoters, goldeneyes, buffleheads, mergansers, eiders and oldsquaws make up a tribe of ducks known commonly as sea ducks (Mergini). Sea ducks tend to spend more time in large, open bodies of salt water, though they will sometimes inhabit freshwater areas. They too dive for their food, eating mainly mollusks and fish.

Ruddy ducks are the only stiff-tailed ducks (Oxyurini) to winter in North Carolina. As their common tribal name suggests, their tail feathers are long, stiff and pointed. Their feet are even further back on their bodies than the diving ducks, making it very awkward for them to walk on land.

Of the perching ducks (Cairinini), only one, the wood duck, inhabits the United States. The wood duck winters and nests in North Carolina. Characteristic of perching ducks, the wood duck's legs are forward on its body (further forward than dabbling ducks). They have strong claws for perching, broad wings and a rectangular tail that helps them balance. The male wood duck has been labeled the most beautiful duck in North America. "He's got a big crest and a red and yellow bill, a greenish tinge on his head, two white stripes coming up either side, and a reddish breast sprinkled with white," says Brame. "He has a beautiful, beautiful side. It's a tan gold color with black and white edging on each of his large flank feathers. He's the most striking bird of the bunch."

The wood duck neared extinction during the first part of the century. Some overhunting, but mainly the clearing of forests (wood ducks nest in the hollows of trees near the water) for lumber and farmland, drove the wood duck populations downward. In an effort to help wood ducks find private niches for their eggs, biologists and concerned citizens began a program to build nest boxes for the birds. Populations were revived, but the ducks still need help. Special precautions must be taken as the nest boxes are built, otherwise the nest will be a sure bet for predation from raccoons or snakes.

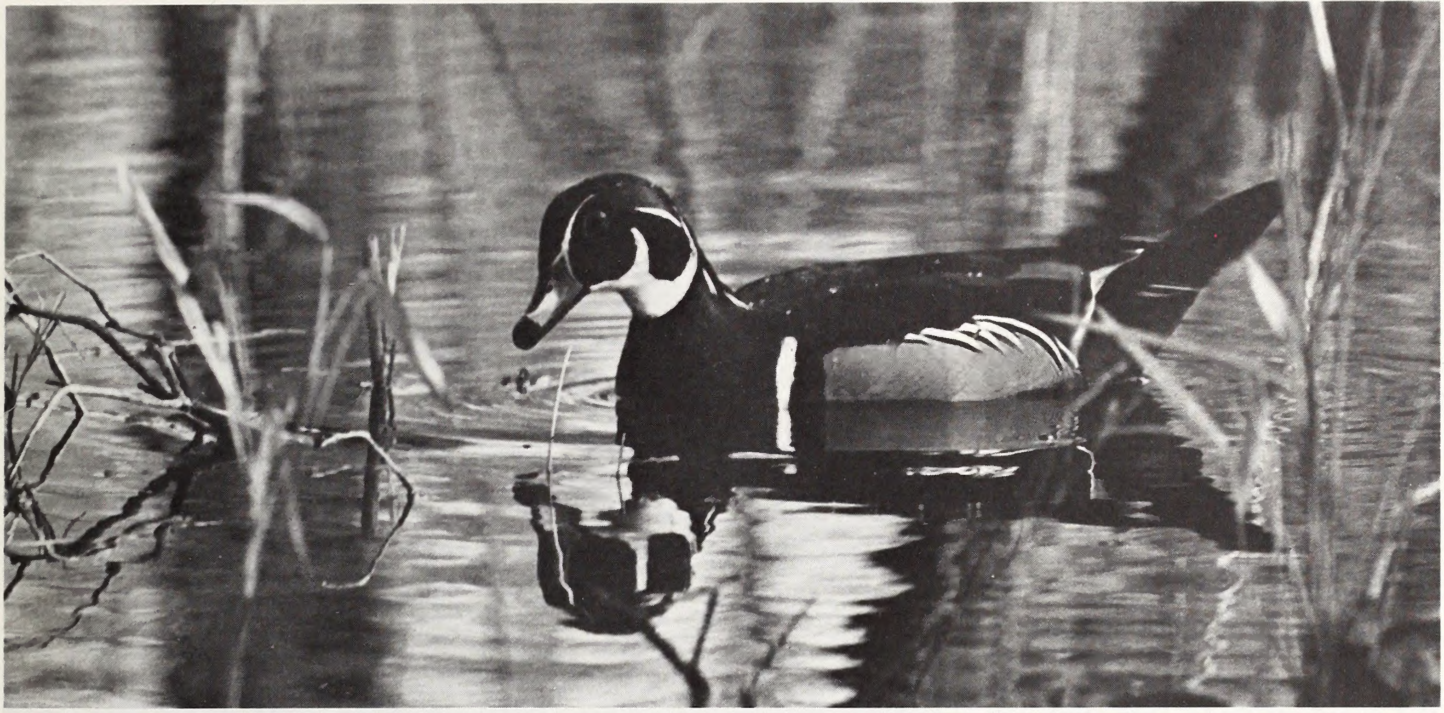
For instructions on how to build a wood duck nest box, contact Gary San Julian, extension wildlife specialist in the zoology department at North Carolina State University.

Whistling swans are the only members of the swan genus *(Cygnus)* to visit North Carolina. Between 18,000 and 22,000 whistling swans scatter themselves between Currituck and Pamlico Sounds and Lake Mattamuskeet (accounting for 50 percent of the whistling swans in the Atlantic Flyway). A visible concentration of whistling swans can be sited at the Mattamuskeet National Wildlife Refuge.

One of the whistling swans kin, the trumpeter swan, formerly wintered in this state. But exploitation of the bird for its feathers during the mid-19th century almost led to the trumpeter's extinction. The trumpeter swan populations have mounted a slow revival, but its wintering range remains limited.

Luckily the whistling swan has not suffered such a fate. In fact, the whistling swan population in the United

Courtesy of the N.C. Wildlife Resources Commission



The wood duck

Photo by Michael Halminski

Black ducks

States has risen steadily for the past 25 years. And in North Carolina, the larger populations are causing wildlife biologists some headaches. Dennis Luczcz, migratory bird project leader for the N.C. Wildlife Resources Commission, says the heavy-bodied birds trample farmer's winter crops as they munch on shoots of wheat. Luczcz says the commission may soon consider a limited hunting season for whistling swans.

Swans share some common characteristics with two tribes of waterfowl—geese and whistling ducks. Part of the same subfamily of waterfowl (Anserinae), geese, swans and whistling ducks display similar plummage among the sexes, mate for life, and molt only once. Among these waterfowl, both sexes care for the young. In contrast, most ducks in the tribes previously mentioned (Cairinini, Anatini, Aythyini, Oxyurini, Mergini), molt twice a year, perform elaborate courtships and mate temporarily. Among these ducks, the court of nature always awards the ducklings to the female to hatch and rear after the divorce.

Each year from the tundra of northern Canada and the Arctic slopes, two species of geese return to the Tar Heel state—greater snow and Canada geese. The greater snow geese whiten the skies along the Outer Banks as some 14,000 to 15,000 birds return to the Pea Island Wildlife Refuge each November (snow geese also winter in the Currituck and Pamlico Sounds).

During the early 1900s when greater snow goose populations were estimated at 3,000 worldwide, Pea Island was the only wintering area for the greater snow geese along the East Coast. But as snow geese made their come back, their wintering area spread as far northward as New Jersey as their numbers have climbed to over 200,000.

The greater snow goose is an Arctic nester and works on a limited time schedule between the lull in Arctic snows during the summer. Most of the geese arrive at their Arctic nesting ground by June 16, Brame says. They lay their eggs within 24 hours of arriving. But if the Arctic spring is cold and snow still covers the ground, most of the geese will not nest, Brame says. Few goslings are added to the flock. To make sure these lean years don't adversely affect snow goose populations,

Continued on next page

Brame says wildlife managers must make sure an adequate adult population of snow geese is maintained for breeding.

While the snow goose has its troubles in the Arctic, its cousin, the Canada goose, is having some problems in North Carolina. Once the wintering capital for Canada geese along the eastern shore, Lake Mattamuskeet National Wildlife Refuge drew 150,000 geese. Now, Steve Frick says the refuge draws only between 20,000 and 25,000 Canadas. What has happened to the Canada geese? They're "short-stopping," which means the Canadas are stopping short of North Carolina for the grain fields of New York, Pennsylvania, the Delmarva Peninsula and coastal Virginia. Many northern farmers switched from truck farming to raising grain, while southern farmers began harvesting their grain crops earlier and leaving less in the fields for the geese to snack on. "Why should these birds come to North Carolina to get steak, so to speak, when they can get steak in New York with less travel," Frick says.

Luczcz says North Carolina is taking the plight of the Canada goose in this state to the Atlantic Flyway Council. The state is asking northern states not to open their season on Canadas so early. It wants to give birds that still have the instinct to winter here a chance to return before they are shot, Luczcz says. "The secret to maintaining a wintering flock of Canada geese is protecting the population already here," he says.

The Wildlife Commission has shortened the season and decreased the bag limit for Canada geese to take some of the hunting pressures off the birds in this state. "Right now we're buying time until an overall decision is made by the Council for the whole flyway," Luczcz says. "It will be a big compromise. Everybody has got to give up something."

To see some of North Carolina's waterfowl, plan a visit to the Lake Mattamuskeet or Pea Island National Wildlife Refuges. Lake Mattamuskeet, the state's largest natural lake, is located in Hyde County a few miles off U.S. 264. The whole refuge is open to birdwatchers. The refuge also has two photography blinds that are available by reservation only.

The Pea Island refuge is located in Dare County along the Outer Banks. Highway 12 runs through the refuge, so a leisurely drive along the banks may find you spotting flocks of snow geese and whistling swans. For large groups, the refuge will organize a tour or you can enjoy the birds on your own.

Waterfowl can also be spotted at the Pungo (south of Plymouth in Washington County) and Swan Quarter (in Hyde County bordering the Pamlico Sound) National Wildlife Refuges. The Wildlife Resources Commission provides 21 impoundments where the public can hunt, photograph or observe waterfowl. For the location of and more information on these impoundments, contact the N.C. Wildlife Resources Commission, Division of Game, 512 N. Salisbury Street, Raleigh, N.C. 27611.

The Marine Resources Center on Roanoke Island plans a waterfowl expedition each fall. Contact the center at (919) 473-3493 for dates and times. To see winter birds other than waterfowl, the Marine Resources Centers at Bogue Banks and Fort Fisher plan bird outings as does the Hampton Mariners Museum at Beaufort.

—*Kathy Hart*

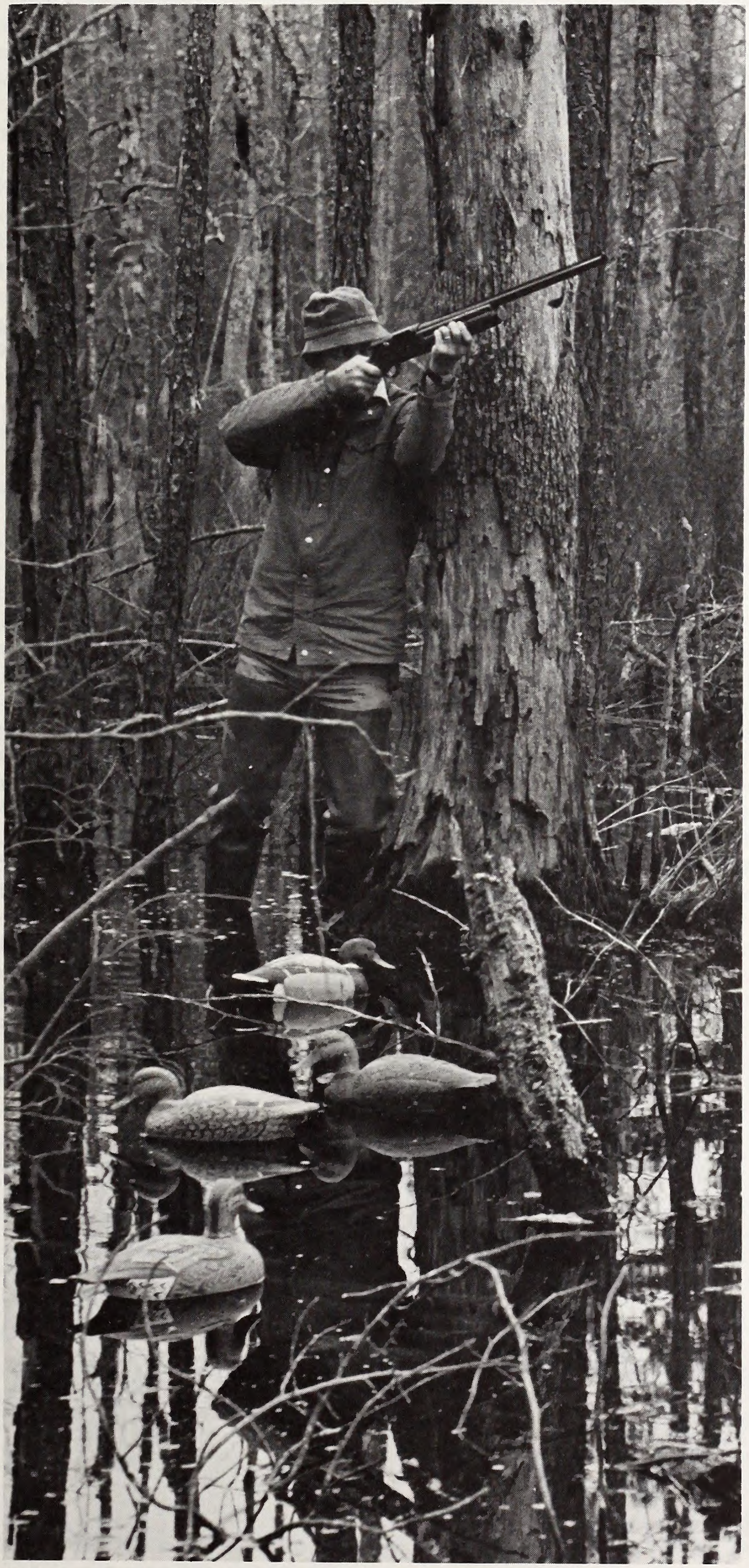
Photos by Dick Brame

Flapping their wings, snow geese catch air to lift them upward for flight

Snow geese losing their heads in sleep and food

A little help for some web-footed friends

Courtesy of N.C. Wildlife Resources Commission



A hunter shoulders his gun for a live target

Old timers talk of days when ducks and geese were so thick they shielded the sun like clouds over Currituck and Pamlico Sounds. No longer does that happen, they say. But many populations, once on the brink of extinction, are on the upswing again, and they owe their revival to state and federal wildlife managers and conservation groups like Ducks Unlimited.

The N.C. Wildlife Resources Commission, as part of its management scheme, operates 21 impoundments, encompassing several thousand acres, to provide suitable habitat for waterfowl. Dennis Luczcz says the waterfowl impoundments or man-made marshes are dyked areas where the water level is controlled with pumps. The water level is maintained at levels that encourage the growth of aquatic plants that are the prime diet for many waterfowl. Most of the impoundments are shallow, brackish water marshes, Luczcz says.

The state also manages a few green-tree impoundments in the Croatan Forest. Under the green-tree system, low-lying hardwood forests are dyked and flooded with water during late fall and winter (during this period the water is not harmful to the hardwoods' root systems). These green-tree impoundments are rich in acorns and seeds, another food source for ducks.

Luczcz says the impoundment system is a costly one to maintain, but funds are provided by fees from gameland permits, hunting licenses and taxes on firearms. Some biologists say the state could do more for waterfowl habitat if state legislators would pass a state duck stamp (in addition to the federal duck stamp fee presently paid to hunt waterfowl). But legislators are hesitant to add the additional fee.

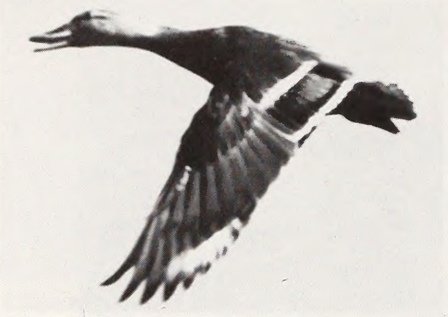
Besides managing waterfowl impoundments, the state wildlife commission also conducts aerial surveys to count waterfowl, investigates disease outbreaks and sets the season for waterfowl hunting. Luczcz says the hunting seasons don't change much from year to year because waterfowl populations don't change quickly. "We look at the overall trends in water-

Continued on next page

fowl populations," he says. "We look at their breeding areas to see the quality of the habitat and the breeding success and the winter census for populations in the wintering areas. We can tell by studying this data whether a population is on the rise or wane."

Luczcz says 23,000 to 26,000 hunters shoot for waterfowl during the season in North Carolina each year. The Wildlife Commission sets a "bag limit" for hunters to follow while hunting. Under the bag limit, hunters can kill only a limited number of waterfowl a day. For instance, during this year's season, hunters are limited to five ducks, seven sea ducks, four snow geese, one Canada goose and two brandt per day. Some states use a point system where each bird is worth a certain number of points and a hunter can only amass a set total of points per day.

The bag limit makes it easier for hunters who can't easily identify ducks and geese on the wing, Luczcz says. But he emphasizes that waterfowl hunters should be able to identify the birds before they go hunting. "Those hunters who make illegal kills or kills by misidentification penalize themselves by making the Commission be more restrictive with our regulations," Luczcz says. "If hunters would just pay more attention to regulations we might be able to have longer seasons and special seasons on certain species." Another problem plaguing managers is a controversy over the lead and steel shot used to kill waterfowl. Hunters have long preferred lead shot over steel because it was denser, had a longer range and had a greater impact. But unfortunately those lead pellets that don't hit the target fall back into the marshes where waterfowl mistake them for seeds. "When the duck takes the shot into his system it is ground up in his gizzard," Dick Brame says. "This releases lead salts into the bird's blood. After these salts build up, waterfowl experience paralysis, usually along the esophagus. The waterfowl starve to death. It's not a pretty sight."



Already, Currituck, Dare and Pamlico Counties, North Carolina's most heavily hunted waterfowl counties, have outlawed the use of lead shot (the Wildlife Commission is enforcing these rulings). Some hunters, mad about the steel-shot decisions, maintain steel shot has a shorter range, so hunters wound but not kill their targets. Biologists counter that deaths among waterfowl from woundings don't really match the deaths from lead poisoning. Luczcz adds that recent statistics have shown the most modern steel loads have a comparable or better range than lead shot.

Luczcz says the federal government was going to phase out use of lead in the United States, but debate over the controversy has left U.S. Fish and Wildlife Service treading water over the matter.

To get a broader perspective on waterfowl, the state Wildlife Commission participates in the Atlantic Flyway Council, a cooperative venture between the states along the Eastern Seaboard and Canada to manage the birds in the Atlantic Flyway. The council sponsors research, formulates regulations (that serve as recommendations to the U.S. Fish and Wildlife Service and subsequently the state wildlife commissions) and works on problems facing waterfowl.

Federal help for waterfowl in North Carolina partially comes in the form of four wildlife refuges—Lake Mattamuskeet, Swan Quarter, Pea Island and Pungo. The refuges also use impoundments to provide more winter habitat for the ducks, geese and swans. At Lake Mattamuskeet, refuge managers have worked out a deal with local farmers to feed their winter visitors. Steve Frick says farmers are allowed to grow grain crops, usually corn, on refuge lands in return for leaving a percentage of the harvest in the field.

On a private level, waterfowl get some help from a group called Ducks Unlimited. Some 11,000 North Carolinians belong to Ducks Unlimited, an organization dedicated to conserving and preserving waterfowl breeding grounds in Canada. Don Manley, regional director for Ducks Unlimited in eastern North Carolina, says North Carolina members contributed $1,036,000 last year, the only state to raise over a million dollars east of the Mississippi River.

Manley says the organization spends 80 cents of every dollar collected in Canada, where 70 to 80 percent of all North American waterfowl breed and hatch. Ducks Unlimited funds pay to maintain the Canadian wetland

Courtesy of N.C. Wildlife Resources Commission

A line of ducks stretches endlessly through a marsh where thousands of potholes left by the glaciers of the Ice Age provide nesting area for waterfowl. Drought and flood are natural problems that have long plagued the Canadian wetlands area, but development is now encroaching on nesting habitat.

To help maintain breeding grounds, Ducks Unlimited takes out free, long-term leases from farmers and others in these Canadian wetland areas, Manley says. Then the organization invests in bulldozers and other heavy equipment to build dykes, levees and flood gates to control water level in these prairie potholes.

Already, Ducks Unlimited controls three million acres of Canadian wetlands. Manley says the organization's goal is to control 6½ to 7 million acres, the acreage Ducks Unlimited feels would stabilize the continental waterfowl populations for the future.

Last year, Ducks Unlimited raised $25.1 million nationwide to raise its 44-year total to $134 million for waterfowl conservation. Manley says the organization is saving waterfowl nesting habitat almost single-handedly, since neither the Canadian government nor other conservation groups have shown little interest in helping waterfowl.

Opponents of Ducks Unlimited say the organization neglects waterfowl in the United States. But Manley counters that taking care of the breeding area is vital to maintaining the population.

The majority of Ducks Unlimited members are hunters, Manley says. "Many hunters feel that if they are harvesting part of the population they should be the ones to conserve it," he says.

Flocking to Currituck, hunters and waterfowl

Say duck hunting in Currituck County and stories of big duck kills, fancy hunting clubs and wooden decoys roll off natives' tongues like rain off oil. Steeped in a waterfowl tradition, the Curritucklan's livelihood has often depended on hunters' guns.

But its no wonder that waterfowl reign king in Currituck. The county harvests more waterfowl per square mile than any county in the Atlantic Flyway. Biologists estimate about 15 percent of the wintering waterfowl population along the Atlantic Flyway chooses Currituck Sound as their winter home.

But Currituck Sound hasn't always been such a waterfowl haven. It wasn't until after the 1820s when the New Currituck Inlet closed and sound waters freshened that flocks of waterfowl began beating at Currituck's door. The fresher sound water supported the aquatic plants like wild celery and widgeon grass that draws ducks and geese. And draw it did.

Hunters, many of them Currituckians, began cashing in on the abundant waterfowl by the barrels, literally, during the late 1800s and early 1900s. Remembered as the "market days" in Currituck County, large quantities of ducks and geese were killed and shipped in large wooden barrels to northern restaurants. Hunters were killing hundreds of birds a day. "It's recorded that Russell and Van Buren Griggs killed 789 ruddy ducks in one day," says Neal Conoley, education specialist with the Office of Marine Affairs who is looking into the waterfowl history of the county. Conoley says that for many county natives hunting waterfowl became a business, and for others a supplement to their incomes.

To kill such large quantities of birds, hunters used a variety of methods now illegal. One such method involved baiting the birds with corn. Conoley says in one four-mile stretch along Currituck Sound 180 bushels of corn were spread a day to bring the birds into the marsh for the kill.

Another popular hunting method before 1918 (the date the Migratory Bird Treaty Act was passed outlawing the more extravagant forms of hunting) involved night hunting with a firelight rig or a sneak box, Conoley says. Hunters would put a lantern in a box on the bow of their boats, then sneak up on a flock of ducks and lift the box off the lantern. Blinded by the light, the birds were literally sitting ducks for hunters.

Some hunters used battery or sink boxes to bag large numbers of waterfowl. The boxes floated at water level with flaps to the sides. A one-man operation, the hunter would lie in the box waiting for the decoys to draw in the ducks. Not able to discern the hunter's trick, the ducks would fly in at

Continued on next page

Courtesy of N.C. Archives and History

Hunting restrictions make kills like these unlawful today

Courtesy of N.C. Archives and History

In this 1930s photograph, these hunters return from the marsh saddled with their catch

close range. Sink boxes were outlawed in the mid-1930s, Conoley says.

Word of Currituck's waterfowl lode spread northward during the later 1800s and the wealthy of New York and Boston came to isolated Currituck County to see for themselves. Amazed by the abundant waterfowl there, many of these northerners formed clubs and bought up large tracts of marsh. Travis Morris, a Currituck County realtor whose roots grow deep in Currituck County, says the land was sold for as little as 10 cents an acre.

The first club to form was the Currituck Shooting Club in 1857. Chartered by 15 members, the club immediately built a clubhouse. Morris, whose father, Chester Morris, a lawyer, represented many of the clubs, says records for membership in this exclusive club included such names as Morgan, Fairchild and Rockefeller. The clubhouse was replaced in 1879 by a larger house that stands today. The only club still operating on a membership basis, the Currituck Shooting Club, has 12 members and an entry fee rumored to be $100,000.

While the Currituck Shooting Club boosts the most exclusive membership, the most striking clubhouse to grace the Currituck marshes belonged to the Whalehead Club. First known as the Lighthouse Club, the club was chartered in 1874 and passed through several groups of stockholders before it was bought by Edward Collins Knight Jr. in 1922.

Historians say Knight bought the club because his new wife, who liked to hunt, was not allowed at the Lighthouse Club.

Built between 1922 and 1925, the new clubhouse carried with it the extravagance of the times. The three-story house, built for a reported $383,000, had 20 rooms, 10 full baths and two half baths on the three main floors and 16 rooms in the basement. The roof was copper, the pipes brass, the floors cork, the chandeliers tiffany glass and the walls were covered with corduroy, Morris says.

Knight died in 1936 and the club was sold to Ray T. Adams, a Washington, D.C. meatpacker. Adams named the property the Whalehead Club and used the clubhouse to entertain friends and clients, the likes of which included governors, U.S. senators and congressmen, Speaker of the House Sam Rayburn and boxer Jack Dempsey.

"By buying up most of the marsh, the clubs preserved the natural beauty of the land here. Our natural resources are this county's main asset."

—Travis Morris

Jarvis Snow, who was a guide at the Whalehead Club before World War II and whose father served as superintendent there for 28 years, says the club was a hub of activity during hunting season. "Everybody was up way before daylight," Snow says. "The upper folks ate in the dining room. My mom cooked breakfast for 'em. We'd all leave the clubhouse just before daylight, everybody in four skiffs. As we went along we'd drop off two hunters and a guide at each blind. They'd hunt most of the morning, then we'd collect 'em for lunch. After lunch we'd take 'em out for the afternoon.

"Some of the guests were great skeet shooters, but couldn't hit a duck or goose in the marsh no matter how hard they tried," Snow chuckles. "They always blamed their troubles on their guns, too."

Snow says Adams leased the club during World War II to the U.S. Coast Guard for a training area on the condition that his father be made a Chief Bos'n Mate and be stationed at the club to protect Adams' interests. Snow said the Coast Guard looked after the house well and returned it to Adams in better shape than they received it.

Adams had dreams of developing the area into a vacation resort, but those dreams died with him in 1958. Since then the property has passed through numerous owners and was finally bought by realtors in 1971, then divided into lots. The clubhouse still stands abandoned and deteriorating.

Besides the Whalehead and Currituck Shooting Clubs, other major hunting clubs were the Martin's Point Club, the Swan Island Club, the Narrows Island Club, the Monkey Island Club and the Pine Island Club. Morris says the clubs were in their heyday between 1880 and 1930. He says hunters arrived by railroad where they were picked up by boats, first sailboats and later motorboats, or by horse and buggy and carried to the clubhouses. "Those who came stayed for a long time because it was such a job to get here," Morris says.

Morris says the wealthy clubs were an asset to Currituck County. "By buying up most of the marsh, the clubs preserved the natural beauty of the land here," Morris says. "Our natural resources are this county's main asset. We don't have industry or commercial fishing to fall back on." Morris says the clubs provided a lot of jobs for the natives of the remote county. Also, many wealthy club members donated heavily to county schools and libraries.

Today, the Swan and Monkey Island Clubs are owned by the Nature Conservancy. Earl Slick of Winston-Salem bought the Narrows Island and Pine Island Clubs (he has since deeded the Pine Island Club to the National Audubon Society).

While wooden decoys and dogs seem synonymous with waterfowl hunting, that's not always been the case. Hunting with dogs has become popular during the last 50 years and Neal Conoley says some hunters near the turn of the century used live ducks and geese as decoys. The ducks and geese were either trained to hold their position or tied into place. Hunters would throw in corn to the live decoys so they would feed and draw in their wild companions. Dick Brame says old hunting guides in Currituck County claim that some hunters had geese trained to fly into passing flocks and bring them down to the hunter's firing range. "They could easily spot their own goose as the flock swung in because it was usually larger with a squarer breast from being better fed," Brame says.

Conoley says decoy makers began making wooden decoys about 1880, but they were not in prominent use until the 1920s and 1930s. A typical decoy stand for a hunter was 200 wooden decoys.

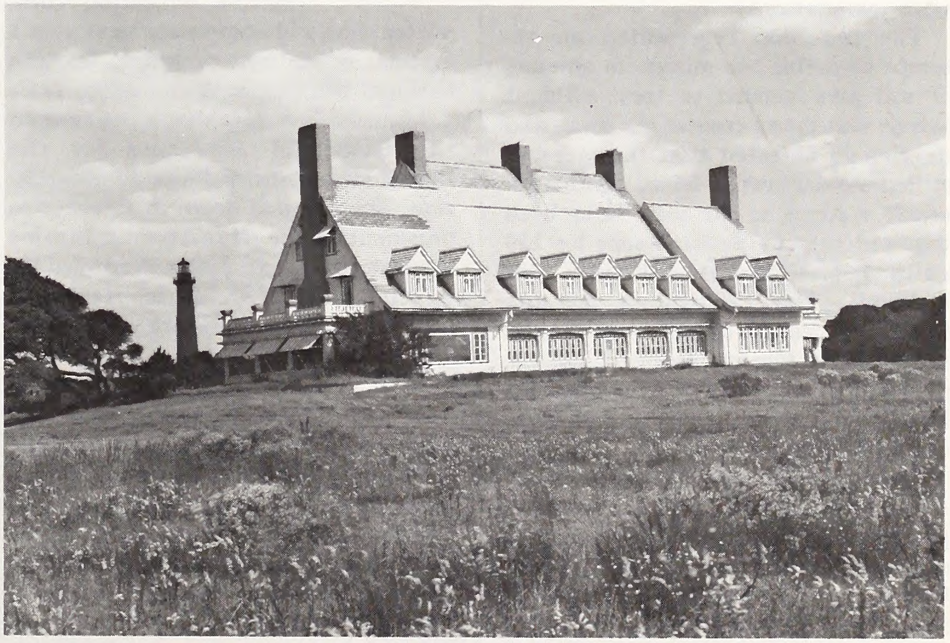
"Decoy-making was a folk art in Currituck County," Conoley says. "Many of the early decoys were blocky and crude, but very functional. The canvasback goose decoy was typical of the time. It had a wooden bottom with a brass wire frame that makers stretched canvas over to form the body. The body was painted and a head carved to complete the decoy."

Jarvis Snow remembers his father, Dexter Snow, chopping out the bodies of decoys with a hatchet. "He didn't work on 'em steady," Snow says. "He'd cut the bodies out one time and whittle the heads another. Before you knew it, though, he'd have ten or twelve or fifteen decoys. He probably made ten thousand decoys during his life."

Snow remembers a lot of the decoy makers whose works are now valued as collector's items—Ned Burgess, Wallace and Pat O'Neal, Joe Hammond, Marvin Midgett and Bob Moss. Conoley, who collects old decoys, says each maker had his own style of making the decoys that distinguished them from others (decoy makers did not initial their work). Old wooden decoys not lost or used as firewood are being collected today as a reminder of the days when wealthy gentlemen gathered around the clubhouse fires at night after a day hunting ducks and geese in the Currituck marsh.

—Kathy Hart

Courtesy of N.C. Archives and History



Photographed in 1972, the Whalehead Club reigns king over the Currituck marsh

THE BACK PAGE

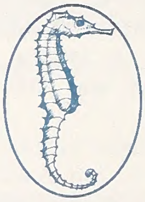
"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).

The state's laws regarding septic tanks are once again under fire, both from those who would relax them and from those who believe they should be more strict. (The June/July issue of *Coastwatch* reported on the debate over the use of septic tanks on barrier islands.) Under pressure from several coastal communities, the state legislature recently dropped a provision, favored by the Division of Health Services, that would have set a maximum sewage flow of 1200 gallons per acre, per day for conventional septic-tank installations.

The provision represented an attempt to define the minimum amount of soil area needed to treat effluent safely. But many coastal residents and developers objected that the measure stifled new growth. Most residential septic systems in the state have been required to provide treatment for 150 gallons of effluent per day, per bedroom. The 1200-gallon measure would have allowed only eight bedrooms, or two typical beach houses, per acre. Many coastal developments have been laid out for twice that number of houses per acre.

Bobby Carlile, an NCSU soil scientist, is conducting a Sea Grant research project investigating the performance of septic tanks on barrier islands. Carlile has joined other scientists and sanitarians on a committee formed to recommend to the legislature alternatives to the 1200-gallon rule. The committee will recommend revision that would increase the minimum area of drain field required for conventional septic systems, and would decrease the per-bedroom rate to 120 gallons a day. The legislature will hear their recommendations this fall.

Research by Carlile and others has shown that, in the porous, sandy soils of barrier islands, untreated sewage from conventional septic tanks can leach into shellfish beds and groundwater supplies. In previous Sea Grant studies, Carlile designed several advanced septic systems, employing low-pressure pumps, that performed well on some marginal coastal soils and helped make development possible on sites once classified as unsuitable. His current project is designed to determine whether these new designs might also offer some relief for the problems on the sandy barrier islands.



Lundie Mauldin, UNC Sea Grant's marine education specialist, was elected president of the National Sea Grant Association's marine education committee. She will coordinate next year's marine education program for the national meeting in Washington, D.C.

Mauldin is also taking a position on the Board of Directors for the National Marine Education Association. She stepped down in October as president of the Mid-Atlantic Marine Education Association. Ned Smith, director of the N.C. Marine Resources Center at Bogue Banks, succeeded Mauldin as president.

While not serving on national committees and boards, Mauldin is often traveling across North Carolina teaching more folks about coastal creatures, plants and processes. A recent program at the Catawba County Museum of Science in Hickory found Mauldin explaining the "World of Squid," in a program complete with slide show and samples of cooked squid.

A few weeks later, Mauldin was discussing the pros and cons of "Eating or Being Eaten by Sharks" in a program at the N.C. Museum of Natural History in Raleigh. Mauldin identified some of the sharks found off the North Carolina coast, then fried up a sample to show her audience it's far better for people to eat sharks than vice versa.

Public facilities interested in Mauldin's programs can contact her at UNC Sea Grant, 105 1911 Building, North Carolina State University, Raleigh, N.C. 27650-5001. The telephone number is (919) 737-2454.

River herring populations have dropped in the Chowan River during recent years. To get a handle on the cause of these declining populations, Bob Sniffen, a Sea Grant researcher from East Carolina University, is looking at the river herring at an early age (larval) to see what factors might affect their survival.

Sampling in Catherine Creek, a tributary of the Chowan River, Sniffen learned that larval river herring concentrate about 25 feet from the stream's edge—the slower-moving portion of the river. The larvae also move with their food source, zooplankton, to the surface at night and downward during the day. Since rainfall was low during the spring, Sniffen says the larvae were moving further downstream than usual in search of a better oxygen mix in the water.

Sniffen had hoped prevailing winds and lunar tides would push Catherine Creek out of its banks and into the floodplains during the spring. He wanted to see how this inundation affected the larval river herring, but conditions never materialized to create the usual spring floods.

Though the information Sniffen has gleaned may seem like disjointed pieces of a puzzle, put together they may tell Sniffen and fisheries managers the critical point in a river herring's life cycle.

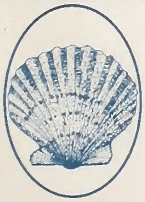
Erosion is no stranger to the North Carolina estuarine shoreline. Both a normal and continuing geologic process, typical erosion rates average one to two feet per year. Property owners have only a few options in dealing with this erosion. A bulkhead is one.

Bulkheads primarily prevent erosion of the high land upland of the wall. But each of the several designs of bulkheads has its own benefits and limitations. Sea Grant's new publication, ***A Homeowner's Guide to Estuarine Bulkheads***, discusses these aspects of bulkheads in addition to common construction problems and design considerations to look for when buying one. Written by Spencer M. Rogers, Jr., Sea Grant's coastal engineering specialist, this guide includes a glossary and sources of additional information for homeowners new to estuarine bulkheads.

For a free copy of this publication, write Sea Grant, Box 5001, Raleigh, N.C. 27650-5001. Request publication number UNC-SG-81-11.

One of Sea Grant's most popular publications has been revised. *Seashells Common to North Carolina*, first published in November 1971, recently came under close scrutiny by co-author Hugh J. Porter of the UNC Institute of Marine Sciences, and it emerged updated. The new version contains not only all of your old favorite seashells, but also several new species and many changes in scientific classifications.

To obtain a revised edition, send 75 cents for each copy to Sea Grant. Ask for publication number UNC-SG-72-09. Don't forget that the best time to look for seashells along the North Carolina coast is after a winter storm.



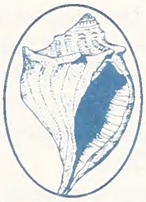
UNC Sea Grant Director B. J. Copeland has awarded two new mini-grants. The first goes to Spencer Rogers, Sea Grant's coastal engineering specialist, to build a ripple tank at the Fort Fisher Marine Resources Center to demonstrate wave dynamics. By watching the tank simulate beach processes, center visitors will have a better understanding of how waves shape our beaches. The ripple tank will also be designed so that visitors can move model breakwaters and other submerged objects to see the resulting wave and beach changes.

Another mini-grant was awarded to J.E. Hobbie and B.J. Peterson, two scientists with the Marine Biological Laboratory in Woods Hole, Massachusetts. They plan to complete a 17-chapter book, begun earlier, on the ecology of the Pamlico estuarine system.

Problem: You want to buy a boat, but you can't afford a new one. You've thought about buying one used, but you really don't know how to go about it. So, what do you do? Get a copy of ***How to buy a used boat***.

Written by Bob Hines, Sea Grant's marine advisory services agent at Bogue Banks, this publication is designed as a guide for the prospective used-boat buyer interested in small, recreational power-boats and sailboats. Specific information and a checklist is provided on evaluating and rating the boat and determining the price to offer. A glossary of boating terminology is also included.

To obtain a copy of this free publication, write Sea Grant. Request publication number UNC-SG-81-10.



Sea Grant researcher Mark Sobsey of the University of North Carolina at Chapel Hill, in conjunction with researchers at the National Institute of Health in Bethesda, Maryland, has developed a strain of hepatitis-A that will grow in cell culture. The strain can now be produced in large quantities for research, an important step toward understanding the virus.

Sobsey is transporting some of the hepatitis-A back to North Carolina for use in his shellfish contamination experiments. Hepatitis is one of the most serious viral diseases contaminated shellfish carry. Sobsey plans to contaminate oysters and clams with the hepatitis-A strain in the laboratory. He will then test the standard methods for detecting other viruses to see how well they detect the presence of hepatitis in the shellfish.

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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To help us specialize our services, please answer these questions.

I am in the following line of work:

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__Commercial fishing
__Educator
__Farming
__Homemaker
__Lawyer
__Marine operator
__Marine recreation
__Mass media
__Seafood processing/marketing
__State government
__University professor/researcher
__Other ______________________

Coastal property owner __yes __no   Boat owner __yes __no

Don't be surprised if someday you see a giant crab stalking the beach near Duck. Thirty-five ft. high, 25 ft. wide and weighing 15,000 pounds, this crab is no typical crustacean. It's the coastal research amphibious buggy (crab) designed and built by the Wilmington District of the U.S. Army Corps of Engineers to collect data on the ocean bottom. Its home is the Corps' Field Research Facility a mile north of Duck.

Powered by a Volkswagen engine, the tripod-shaped vehicle rolls out into the water with scientists perched atop. The crab is capable of going out to depths of 30 ft. for bottom-sampling. The facility's staff used it during tropical storm Dennis to record the storm's effect on the bottom.

But the crab isn't the only attraction to scientists using the Field Research Facility. Four years ago, a 1,840-ft. steel-piling, concrete pier was built and fitted with wave gauges, wind instruments and other equipment feeding data into the lab's computer system. Equipment is checked four times daily by the staff of 10 for numerous changes in the beach profile.

According to Kurt Mason, chief of the facility, the area has been available, not only for Corps-related projects, but also for research by universities and science foundations at no charge. Last year, Sea Grant researcher Ernie Knowles from North Carolina State University (NCSU) joined 40 international scientists at the facility for a two-month study on wave direction and generation. Knowles' test buoy floated beside buoys from Canada and Norway, providing participants a chance to compare equipment and data.

Two other Sea Grant researchers, Tom Curtin and Yates Sorrell of NCSU, have used the facility's pier in their work. Twice, they have set out their current-monitoring gear on brackets mounted to the pier, and have matched data with that collected by the facility. "That's one of the most valuable things about this facility," Curtin says. "Not only do they have an excellent platform, but also complementary data."

Any individuals or groups interested in the Field Research Facility should contact Kurt Mason. In addition to oceanographic experiments, Mason says, "we think this pier is also excellent for biological sampling." The staff gives guided tours of the pier and part of the facility each weekday from Memorial Day to Labor Day. For more information, call (919) 261-3511.

Come Christmas, some people count more than gifts under the tree, they count winter birds for the National Audubon Society. Each winter during a two-week period specified by the society, birdwatchers gather for a single day of intense bird-counting. Biologists think Christmas time is the period when winter bird populations are the most stable. The groups search an area 15 miles in diameter to determine what species are present and how many birds there are.

Jim Parnell, a biologist at UNC-Wilmington and a bird expert, says the Wilmington group he counts with spotted 148 species of winter birds last year. Parnell says a friendly rivalry develops between counting teams as they compete to see which groups can spot the most species of birds. Last year 18 groups counted birds across North Carolina.

After a day of counting, the groups compile their statistics and send them off to the National Audubon Society (each group already has registered with the society). Audubon then publishes the statistics of each group in its July edition of *American Birds*. The Carolina Bird Club also publishes a summary of the North Carolina count in its publication, *The Chat*.

Some biologists put little stock in these statistics, saying they are gathered haphazardly. But Parnell says the counts can give biologists trends in overall bird populations.

If your club or group would like to count birds, find out how by writing the National Audubon Society.

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